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TELEPHONE STATISTICS.

The United States Bureau of the Census has just issued its bulletin on the telephone and telegraph industries of the country, bringing the statistics up to the end of 1902. The data are presented in admirable detail, and we are glad to present some of the figures in this issue. They give the authoritative outlines of a great telephonic development, and of a less marked growth of the telegraph. As for the telephone, it bids to be not less wonderful in its utility and universality than it has been as a subtle invention and a refined engineering art, and these figures show how remarkably it is already subserving public necessities. One part of the data of deep interest to many of our readers will be the relative statistics of the Bell organization and of the independents. It will be seen that the Bell system shows up much better than had been expected, and that it preponderated heavily, although some independent statements to the contrary have been widely quoted. Probably since the compilation of the figures, the Bell system has improved its position; at least that is the general opinion in the electrical field. The Government report shows over 80,000 independent subscribers connected into the Bell network and the number has largely increased. As to "independent" companies, we have heard non-Bell banking interests state that at least 1,000 of the so-called independent plants are Bell by affiliation or control. That seems improbable, but the proportion is undoubtedly large. Be that as it may, the struggle and competition of these great rival interests has done wonders in fostering the spread and improvement of the telephone art and in bringing it close to the people.

A BUREAU OF MISINFORMATION.

The office of the Comptroller of New York City is a saddening spectacle these days, while an alleged inquiry into the cost of electric lighting is going on. The facts of the case are virtually *res adjudicata*—contracts under which goods have been ordered, delivered and consumed. Now, to "dispute" the bill the Comptroller is apparently trying to prove that they did not cost the contract price and that if he can establish such a point the bill will not be paid, and the city may go in for an electric light plant. The situation is exactly analogous to that of a man who goes into a restaurant, orders from the bill of fare, gets a good square meal, refuses to pay because the proprietor could perhaps buy steak for half the menu price, and then to save his face threatens to eat no more chop house steaks, but cook his own at home. They say the Comptroller is an honest man, though bitten deep by political ambition; but if he is sincere, how he can dispute bills for services contracted and rendered passes our understanding.

And then the conduct of the inquiry is so trivial and evasive. The officials of the company naturally stand on their rights as citizens, and even if honest attempts are being made to reach the men who know cost of production, the thing becomes ridiculous when witnesses 88 years of age, holding honorary positions, are closely questioned as to capitalization figures of minor companies over twenty years ago! Moreover, the investigation is not straightforward. In order to "prove" cheap production of electric lights, the managers of municipal plants in other cities, unsworn, have been brought forward ostentatiously to show that by leaving out sundry vital items a central station must meet, the cost per lamp can be paraded as around $50. This leaves out such things as insurance and taxes, often rent,

usually includes very little or no depreciation, and on the whole means little or nothing. Besides, the real facts do not emerge in such a hurried inquiry, but next morning the newspapers headline the wildest statements in the bunch as being a real representation of the facts, and the average reader is fooled again. The New York *Times* did this recently, for example, but came out the next morning editorially and pointed out how gross was the deceit thus effected, and this in turn was followed up in that journal by an admirable letter which pointed out that while the Chicago expert claimed less than $60 for his lighting expense per lamp, Haskins & Sells, well-known accountants, had proved that over a period of thirteen years it had actually run $165.62 in cost to the city, to come out of taxation somewhere. The highest price paid by New York for better service has been $146.50. Moreover, as to the expert from Baltimore, the letter states that in his Cleveland municipal report he left an item of $130,000 out of an estimate of $375,750. The omission may have been innocent, but it ought to put municipal advocates here on their guard. It is further pointed out in this letter that eight cities with municipal plants gave last year an average of 346 cp for 1 cent, while Manhattan Island, the dearest place on earth, got 477 cp for 1 cent. Yet the entire cost of street electric lighting in New York is only 23 cents annually and 7 cents more for public interior lighting, or 30 cents out of the annual city expenditure of $30 per capita.

The Comptroller, whose lighting campaign already "looks like thirty cents," is out for an appropriation now of $25,000 for further inquisitorial, tenebrous marauding on the lighting interests, and other investigations are in the air up at Albany, all for political effect, although avowedly for the dear public. All the talk of overcapitalization has nothing to do with the case. It certainly occurs, but it will never be cured or checked by this kind of performance. There should be some kind of offsetting influence, however, and we venture to suggest that it is about time the National Electric Light Association got busy. It put in a tardy appearance at the last hearing, and met scant courtesy, but, as representing the property and welfare of some 3,000 central stations, it must check the spread of these lying misrepresentations which are being quoted all over the country as facts. Fire must be fought with fire, and the ugly facts as to municipal ownership now suppressed by the Comptroller and others must be brought out in all their serious implications of extravagance, mismanagement, inefficiency, political corruption and frequent bankruptcy. If there is good municipal plant service, it should be provable, and so should good private service, but it will never come from such a pretentious bureau of misinformation as the irresponsible office of Comptroller Grout.

THE N-RAY MUDDLE.

Nothing more beautifully illustrates the intimate way in which physics and metaphysics rub elbows in modern science than the almost inextricable tangle of evidence woven around the reputed N-rays of M. Blondlot. When announced it was in such fashion as to command an immediate and respectful hearing both on account of the eminence of the discoverer and the inherent probability of some such find of unknown radiations. Then the investigation was taken up by M. de Lepinay, the younger Becquerel and others of less eminence and M. Blondlot's results were apparently confirmed. Presently the English and German investigators began work and got no results, but this of itself would not have led to widespread skepticism had not worse things happened. The unhappy N-rays were taken up by that extraordinary psycho-physico-pathological group of Nancy which for years has purveyed esoteric science of strange and wonderful kinds. These savants made up for the things which the English and Germans did not see by seeing altogether too much and presently carried the luckless rays into the hopeless mazes of theosophy. New and remarkable modifications of N-rays turned up with dazzling rapidity and aroused a general feeling of distrust in the whole affair, which was not allayed by the failure of many careful experimenters to verify even M. Blondlot's original results. Distrust ripened into open incredulity and presently people began to raid Blondlot's laboratory, obtaining in the main little better results than elsewhere.

The reports of these visitors have generally inclined to the condemnation of the whole affair as without physical foundation, the result of the self-deception which may accompany a strong prepossession. Certainly various subjective phenomena were discovered. It is only fair to M. Blondlot to say that the visitors were warned of the probability of this in advance, and that, from the reports as published, it is pretty clear that the investigators as a rule made their visits after being well saturated with disbelief, owing perhaps to the queer things which had been seen at Nancy. At best the N-rays as reported by Blondlot could not be dealt with directly, but only by their differential action on a phosphorescent screen or a tiny spark. Any one familiar with the observation of such phenomena must recognize the danger of confusing the subjective with the objective, even granting that the latter has a definite and determinable existence. On the other hand, where objective and subjective phenomena are mixed, it is more dangerous to deny the objective than to affirm the subjective or accidental. In astronomical observations, for instance, much of importance has come from the conscientious discussion of supposed observational errors through which ran a vein of phenomena. It is too soon to forget how argon was found in assuming that a trivial discrepancy in the density of nitrogen was real instead of casual, or how thiophene was missed by one of the world's greatest chemists through the opposite assumption of a careless analytical assistant. If two or three careful experimenters unite in observing certain phenomena of a new and conspicuously difficult character, something more than inability to observe them on the part of others is necessary to prove their unreality.

It is, therefore, distinctly "up to" those who believe that M. Blondlot and the more conservative of his colleagues are mistaken, to show the cause of their error in some more definite way than by calling the phenomena subjective. The case for the N-rays has certainly been greatly damaged by the activity of the Nancy contingent who see too much, but this does not properly affect the main question. Blondlot now claims to have objective evidence of a conclusive character which will have to be duly weighed. Certainly the subject is well worth investigation, for the N-rays are either one of the most remarkable discoveries of recent years or by all means the most noteworthy illusion. Possibly one of the Italian investigators who repeated successfully Blondlot's fundamental experiments, but in going further found himself inextricably mixed up in subjective phenomena, may have the rights of the matter. Queer things of an illusory character do happen in science, but since the controversy about an intra-Mercurial planet was at its height there has been nothing more striking than the N-rays case. The great Leverrier to his dying day affirmed the existence of Vulcan, and few eclipse parties even now fail to bear it in mind, but the negative evidence is considerable in that most of the reported observations have been now traced to definite objects, which is a very different thing from saying that the observers were mistaken. Some such process of elimination must be applied to the N-rays before one is justified in stigmatizing Blondlot and de Lepinay as self-deceived visionaries. Every question of this sort deserves very thorough investigation for its own sake, as well as for the sake of those whose judgment is impugned.

MODERN VIEWS ON MATTER.

The last Annual Report of the Smithsonian Institution, recently published at Washington, contains a lecture on "Modern Views of Matter," given by Sir Oliver Lodge at Oxford University. The lecture has the strong English, the precise and lucid enunciation, as well as the daring speculation, of that well-known physicist. The lecture breathes the ideas of microcosmic astronomy, in which planets are the electrons. All matter is assumed to be composed of atoms, and all atoms are astronomical systems of electrons, whirling in their tiny orbits. The diameter of an electron is the one-hundred-thousandth of the diameter of an atom; so that if an electron be magnified to the size of an ordinary shot, the diameter of the atom would be about equal to the height of the Washington Monument. All of the electrons are inherently electrified, and are nothing more than floating electric charges, some negative, others positive. Consequently, if we had sufficiently powerful vision, far beyond the power of the microscope, we should see that eventually every kind of matter consisted finally of electrons or of electricity, one astronomical system forming an atom of hydrogen, another, more populous, an atom of chlorine, and so on. The inertia of matter is attributed entirely to the electric inertia or self-induction of the electrons forming atoms.

When an electron moves in a straight line at constant speed, it does not perturb its environment, nor does its environment influence the motion. When, however, an electron alters either the direction or the velocity of its motion, there will be a mutual disturbance of, or reaction between, the electron and the ether in which it swims. The reaction produces a disturbance in the ether, consisting of electric radiation, transmitted in wave form, the energy of radiation increasing as the square of the electron's acceleration. The reaction also produces a disturbance in the motion of the electron, such as we recognize in a body possessing mass, or inertia, under the action of moving forces. When an electron is suddenly stopped by collision with an atom, the sudden retardation throws off a powerful solitary wave of electric radiation that we call a Röntgen ray. When an electron swings in a minute orbit with sufficient velocity, under the influence of heat energy, the centripetal acceleration gives off electromagnetic radiation energy that we call radiant heat or light, according to its wave length, or to the length of the electron-year—the minute periodic time of revolution around its orbit which determines the frequency.

Occasionally, electrons in performing their planetary orbits within the atomic system, attain a velocity far above the average, a velocity equal to, or nearly equal to, that of light. At this critical velocity, a critical dynamic condition is brought about. The mass of an electron due to its self-induction is not an absolute constant, but depends upon the velocity. It is substantially constant at all ordinary velocities, but near the velocity of light it rises rapidly, and at the velocity of light it becomes infinite. A planetary system of electrons is, therefore, liable to disruption, when the velocity of an electron attains so unusually high a value as the light velocity. Possibly a collision between electrons might bring this about. The liability to collision would be greatest in atoms having the largest number of electrons—that is, atoms of large atomic weight. At any one time, possibly one atom in a million millions develops this critical condition and disrupts, its electrons then tending to form a new planetary system corresponding to some other chemical element. This disruptive decay is perhaps not confined to radium, thorium, polonium or uranium, but may be disseminated in some degree through all matter. According to this view, nothing in the known universe is entirely stable. Not only suns, planets, satellites and worlds change and pass away, but also mountains, oceans, solids, liquids, gases and all atoms. The atom, which is the smallest, may have the longest life of all. On the hypothesis of Lodge's lecture, therefore, the whole material universe is electricity, and all energy is ultimately electrical energy. The doctrine of the conservation of matter and of energy may thus be paraphrased on the above hypothesis. The coulombs and the joules in the known universe are constant.

THE ASSOCIATION OF SUNSPOTS AND MAGNETIC DISTURBANCES.

A long paper on this subject by Mr. E. W. Maunder in the *Monthly Notices* of the Royal Astronomical Society contains a mass of material, as well as some important deductions. It has long been recognized that magnetic disturbances at the surface of our world were in some way connected with sunspots. It was observed that there were periods of sunspot activity alternating with periods of inactivity, the cycle being about eleven years. There are similar periods of activity in magnetic disturbance. Moreover, the maxima and minima of the solar spot activity and the earth's magnetic disturbance activity substantially coincide. Although the simplest supposition is that the sunspots directly affect the earth's magnetic needles, yet it was possible that some antecedent cause gave rise both to the sunspots and to the magnetic disturbances at the same time. It has, however, recently become evident, as this paper of Mr. Maunder shows, that it is necessary to attribute the magnetic disturbance directly to the sun. It seems evident, therefore, that a sunspot is associated with a violent ejection of electrified matter radially away from that area of the sun.

Three forces are known to be capable of acting upon such streams of ejected matter, namely, electric stress, gravitation and light pressure. The electric stress pushing away the matter must rapidly diminish as the matter leaves the sun. Gravitation is constantly attracting the matter back to the sun with a force inversely as the distance. Light, or more strictly, radiant energy, is constantly pushing the matter away from the sun. So the gravitation pull and the radiant push fight it out for the resultant action on the matter. Coarse matter will succumb to gravitation and fall speedily back into the sun; but as the matter becomes more finely divided and offers more surface per unit of mass, the sway of gravitation diminishes. Below a certain critical size of particles, the push will always exceed the pull, and drive the matter away from the sun.

An eruptive sunspot may thus be regarded as a volcano ejecting a stream or jet of negatively electrified matter radially out from the sun. The particles travel outward in a direction determined by the motion received by them when leaving the direct range of influence of the gravitational forces of the sun, and hence continue to travel in a radial direction. The earth in its constant travel through space cuts across the path of these particles which, being electrified, form the essential elements of a current. It is supposed that the finely divided particles in the jet may reach the earth in about two days. They become caught by the atmosphere and constitute an electric current jet in the upper regions of the same, which will naturally affect the magnetic needles on the earth's surface. This disturbance may persist for a certain time after the solar jet has swept past the earth. The same jet can only again disturb the earth after the sun has made a complete rotation, so as again to bring the stream opposite to the earth. This rotation occupies about 26 days. Consequently, if one and the same sunspot is responsible for a magnetic disturbance, the same should recur at each successive revolution of the sun. According to Mr. Mounder's compilation, a number of such successions of two or of three solar spot rotations have been recorded.

The Electric Lighting Inquiry in New York City.

IN his efforts to prevent payment of old electric lighting and gas bills in New York City, Comptroller Grout has, as already noted in these pages, sought to put officers of the New York Edison Company on the stand to show how much the service cost, although it was done under signed contract. Such officers have refused to appear or to testify, the objections raised by counsel being as follows: "We shall object to the continuance of the Comptroller's proceeding on the grounds that more than thirty days have elapsed since the companies' bills were presented to the Comptroller; that the Comptroller has rejected them, and that an injunction is now in force restraining him from paying them; that an action was begun by the company against the city upon these claims before the witness whose committal for contempt is asked for was subpœnaed, and that such action is still pending; that an investigation into the affairs of the company such as the Comptroller proposes to make should be conducted privately for the personal information of the Comptroller and should be treated by him as confidential and should not take the form of a public hearing such as this, involving an exhaustive examination into the private business and affairs of the company, and that any attempt on the part of the Comptroller to enforce such public inquisitorial examination is in excess of any powers conferred upon him and is in deprivation of the constitutional rights of the company and of the witness."

Meantime the Comptroller has gone outside New York for "data" and has called witnesses from other cities to show how cheaply electric light can be produced there as compared with New York. To this counsel for the New York Edison Company has objected, as utterly irrelevant, and the National Electric Light Association has intervened by counsel to object to the false statements going out to the press about electric lighting costs, to the general and serious hurt of the industry as a whole. The counsel are Hunt, Hill & Betts, of New York City. The hearing has also been attended by experts and others interested.

Mr. Charles E. Phelps, chief engineer of the electrical commission of Baltimore, appeared last week as one of the witnesses by whom the Comptroller sought to prove unduly high rates charged for electric lighting. He testified that the 480-watt arc lamp in use in Baltimore is now being paid for at a rate of $99.92 per year, and gave the average cost of lighting per kilowatt-hour as 5.2 cents. He did not state how many of the lights were overhead. He figured the cost in New York at from 8.82 to 11.32 cents per kw-hour. The old rate in Baltimore had been $127.75, then a small municipal plant was started, and the rate was reduced. The Legislature passed an act for a $1,350,000 plant, but the authority has not been exercised. The present contract has been running since September, 1900. New York contracts are made for only one year. Mr. Phelps made a statement that the lamps supplied by the municipality to itself for a time cost only $46, but it appeared that this was only maintenance and operating expenses. "There was no theoretical charge for depreciation." The Comptroller made some figures of his own, bringing the real cost presumably up to over $79, without any allowance for underground work. The present number of lamps supplied in Baltimore is 1,625. Mr. Phelps testified that the Purnell plant in Baltimore of 500 kw capacity he had built was satisfied with 4 cents per kw-hour. Under a contract between the Baltimore & Ohio Railroad and the Baltimore United Railways current was sold at one cent per kw-hour at the switchboard. Mr. Phelps testified that the five forms of standard contract of the New York Edison Company showed a range of prices from 3 to 15 cents per kw-hour. He also stated that the arc light price in Cleveland, Ohio, was $75, but did not give any information beyond that as to underground work, hours of burning, time of contract, etc.

Mr. Edward E. Ellicott, the city electrician of Chicago, was also a witness last week as to the work done by the municipal arc light plant in that city, supplying a little over 1,300 lights. He alleged that the total cost of the plant was about $150,000. The lights were distributed over 150 miles of street, averaging about 8 to the mile. They were now building a new plant for 4,500 lights of 2,000 cp. The present lights were 450 watts. The new would be the same and the machinery and building would cost approximately $172,000. That did not include poles, wires, etc. Mr. Ellicott then asserted that the "total average cost per arc light in Chicago, produced by the municipality for itself, was $53.54." He gave some items as follows: Coal, $18.34; carbons, $4.01; globes, 66 cents; steam plant repairs, $2.10; electric plant repairs, 88 cents; arc lamp repairs, $2.86; circuit and lamp post repairs, $3.44; unclassified expenses, $1.57; superintendence, $1.73; lamp trimmers, $1.31; firemen and engineers, $7.12. This was for 1903, supplying 4,827 lamps. He gave similar figures for other years. The city owned, he said, about 500 miles of underground ducts, in which its wires were run, and built 56,996 ft. in 1900, costing 40½ cents per linear foot, each line having at least two ducts, some more than four. Mr. Ellicott then read from a report of Haskins & Sells, public accountants, as to the excellent condition of his plant. The Comptroller then called attention to the fact that no allowance had been made for depreciation, taxation, etc., and he and his counsel, Mr. Yonge, concluded in a rough-and-ready way that "if we take it on their own basis and still allow 5 per cent. depreciation, it would still keep it away under $70." As to insurance, the Comptroller stated that none of the city departments carried any.

A cross-examination was then made by Mr. Hemmens, who stated that he was there for the New York Edison Company. Mr. Ellicott had given the Western Electric Company as his training school and admitted that it was a manufacturing company, not an electric light company, although it had probably equipped 50 or 60 stations. The Chicago city plant did not run at all in the day time, even on cloudy or foggy, dark days; people then had to depend on the Chicago Edison Company. The lights were not inspected every night. There were three inspectors to go over 2,000 lights, or between six and seven hundred each, leaving 3,000 uninspected nightly. Outages were, however, supposed to be reported promptly by the police. They paid for coal $3.55 and $2.22½ a ton—soft coal. Engineers were paid $100 to $115 per month; firemen, $75; lamp trimmers, $68 to $75; light repairmen, $90; lamp repairers, $83.32; station repairmen, $75; dynamo tenders, $83.32; common laborers, $2 per day. The cost of labor for each light was about $19. About 33⅓ of the lamps were supplied underground—1,819 and 3,008 overhead. He did not have any information as to difference in cost of the two services. The city used to pay private companies $137.50 and in 1888 as high as $200, for overhead wires. The Chicago Edison Company, about 1895-6, made a charge of $103 for overhead lights and $137.50 for underground; in 1898 they made a price of $105 for overhead. The Haskins & Sells report was then taken up and Mr. Ellicott objected very warmly to many of the statements therein showing a cost of the municipal service of $164.69 per lamp. He considered that the accountants had laid against the plant a number of items that did not exist or were too high. The reports in question are most exhaustive and voluminous, including depreciation, water, insurance, etc. Mr. Ellicott claimed that to rent the lights for 17 years would have cost $4,476,245, and that the plant had cost to run, etc., about $4,097,836, and they had the plant also to the good. Mr. Ellicott did not state the assumed contract price for the period. As to taxes, the Chicago Edison plant was there still and the city had not lost any taxes therefore. Mr. Hemmens stated that one of the private companies with an investment in Chicago of $10,000,000 had paid $67,000 a year in taxes, not including franchises. Mr. Hemmens pointed out to the witness that Haskins & Sells added for depreciation, water, insurance, etc., $37.79 per lamp, added to $62.09, making $99.88. Mr. Ellicott testified that his expenses were decreased by going underground, in spite of cost of cables, repairs, etc. In reply to a question by Mr. Betts, it was stated that there was no allowance for water because an equivalent lighting service was given, which if from private companies would have cost $9,350, as against a charge for water of $9,000. About 48 lights were thus furnished. The city was now renting from the Chicago Edison Company about 630 lamps at $103 per lamp in the outlying districts, where there are no underground wires. The city exchanged pole privileges with the telegraph companies.

Mr. Phelps then went on the stand again and described the Baltimore underground system, now about half completed, at a cost per duct, except connections with the distributing system, of a little over 25 cents per duct foot. The companies are compelled to use this at a scale ranging from 7 cents per duct foot to 5,000 ft., down to 5 cents for all over 100,000 ft. This is to cover interest on investment and fixed charges. The system has been in use six years. The damage from the recent great fire had been very slight. Mr. Hemmens, on cross-examination, which was contested, tried to bring out the low cost of fuel in Baltimore and the fact that the prices given by Mr. Phelps for the New York Edison Company were

based only on contract forms and also did not take into account concessions that had to be made by the customer where low rates were quoted.

Meeting of Indiana Electric Railway Association.

The first annual meeting of the Indiana Electric Railway Association was held in Indianapolis January 12. This association was organized December 9 of last year at a meeting of electric railway men held in Indianapolis. The by-laws then adopted provide for an annual meeting on the second Thursday in January of each year, and regular meetings on the second Thursday of each month.

The meeting was called to order by Mr. A. L. Drum, chairman of the Committee of Arrangements, and proceeded to the election of the officers with the following results: President, Mr. Charles L. Henry; vice-president, Mr. J. W. Chipman; secretary, Mr. Paul H. White. Executive Committee, Messrs. A. L. Drum, C. C. Reynolds and Gardner F. Wells. Finance Committee, Messrs. Charles Murdock and N. G. Irwin. The association starts out with a membership of over 60 Indiana electric railway men. During the luncheon intermission the Indianapolis Traction & Terminal Company took the members on a special car to a visit to its power house and shops.

Mr. A. S. Richey, electrical engineer of the Indiana Union Traction Company, presented an interesting paper entitled "Cost of Electric Railway Power Production and Transmission in the State of Indiana." He stated that in Indiana there are about 800 miles of interurban electric railways operating 100 cars regularly, having an average weight of 25.61 tons and an average schedule speed of 20 miles per hour. Twenty-four stations furnish current to these cars, having an installed capacity in generators of about 200 kw for each interurban car operated and 25 kw for each track mile operated. One-half of these stations generate direct current and the other half generate alternating current, which is distributed as direct current from 34 sub-stations. The power station capacities vary from 200 to 6,000 kw and comprise units of every standard rating from 65 to 1,500 kw. Assuming a power consumption of about 100 watt-hours per ton-mile, the total for the 100 interurban cars is about 5,000 kw on the basis of the data given above. The average load factor of a power station, therefore, appears to be about 40 per cent. of the installed capacity, and therefore the average output at the station bus-bars is over 8,000 kw, which appears to indicate an aggregate loss in lines, rail return, sub-station apparatus, step-up transformers, etc., amounting to more than 3,000 kw average, or an average efficiency from power station bus-bars to car motors of, say, 60 per cent. Dividing this loss of 40 per cent. between direct-current and alternating-current stations, and allowing a transmission efficiency of 80 per cent. for the direct-current stations, there is left an efficiency of about 55 per cent. for the alternating-current stations. This efficiency is then divided up as follows: Step-up transformers, 94 per cent.; transmission lines, 97 per cent.; step-down transformers, 93 per cent.; rotary converters, 80 per cent.; direct-current distribution, 80 per cent.; combined efficiency, 54 per cent.

In view of these figures—80 per cent. efficiency for direct-current and 55 per cent. for alternating current—it is concluded that the latter system has been installed in some cases where the much more simple direct-current system would have been the more economical. After discussing the relative economic applicability of the two systems, the conclusion is arrived at that under most circumstances an interurban line of 20 miles in length can be more economically operated with direct current, but that when the length exceeds this the alternating current is more economical.

Replies had been received from letters of inquiry as to the cost of power from companies representing 85 per cent. of the total installed generating capacity of the railway power stations of the State. These stations generate an average of 5,845,450 kw-hours per month, at an average cost of .755 cent per kw-hour. The lowest total cost was .505 cent and the highest 2.024 cents. The items making up the average cost are fuel, .526 cent; labor, .158 cent; lubricants, waste and miscellaneous, .032 cent; repairs, .039 cent. The lowest cost of fuel is .368 cent and the highest 1.405 cent. For labor these extremes are .100 cent and .331 cent; for lubricants, .015 cent and .086 cent, and for repairs .010 cent and .218 cent. Deducting the output of the two most economical stations representing two-thirds of the total output reported, the average cost of the balance of the power generated in the State is 1.021 cent per kw-hour. The above figures correspond to cost of power at station switchboards. Adding sub-station expense in the case of alternating-current systems, the total average cost of power is raised to .964 cent per kw-hour, the lowest reported being .747 cent and the highest 2.024 cents. The average consumption of coal is 5.56 pounds per kw-hour, the highest consumption reported being 10.7 pounds and the lowest 4.9 pounds per kw-hour. The average power consumption is 1.48 kw-hour per car mile for city cars and 5.18 kw-hours per mile for interurban cars. On this basis the average cost of power per car mile is 1.43 cent for city cars and 5 cents for interurban cars.

In the discussion Mr. A. L. Drum cited the case of a railway and light plant in a city, where the change from alternating current to direct-current underground distribution led to a saving of $15,000 per annum in fuel, which paid the interest on the money invested in making the change to the underground system. It is stated that, in the gas belt in Indiana, steam users have found that gas at 8 cents per 1,000 cu. ft. is about equivalent to coal at $1.25 per ton.

Mr. Thomas B. McMath read a paper on "Track and Roadbed Construction" which gave some data concerning treated ties and poles. It is stated that, by creosoting, the life of a tie may be increased from 20 to 25 years, and he cited an instance where creosoted sap pine ties had been in use 15 years and were evidently good for as many more, though this is the cheapest grade of lumber in the section where it was used. The treated ties cost in the vicinity of 40 cents each and the treated 30-ft. sap pine poles could be secured for about $6 apiece. He believes that a good creosoted tie could be secured in Indianapolis for less than 65 cents and that such a tie would last twice as long as the ordinary white oak tie. The treated sap pine pole would also have the advantage over the cedar pole in greater strength. The paper also dealt with concrete roadbed, without the use of ties. In the discussion Mr. Thomas Elliott, of Cincinnati, said that some creosoted ties laid down eleven years ago in Cincinnati are apparently as good as new. To creosote a tie costs about 20 cents. The insulation of creosoted poles is not as good as that of uncreosoted poles.

Mr. Leverett M. Clark, master mechanic of the Indianapolis & Northwestern Traction Company, read a paper on "Construction and Maintenance of Cars and Equipment," which related more particularly to the car body and running gear. In the discussion Mr. Elliott said that a plan successfully used at Grand Rapids for obviating trouble from sleet on the trolley wires was to fasten a chain in the groove of the trolley wheel, the chain being renewed as fast as it wore out. Dr. Louis Duncan, in responding to an invitation to address the meeting, spoke of the great interest attaching to the single-phase system with which the Indianapolis & Cincinnati Traction Company is equipping its lines. He questioned whether too much is not anticipated for the single-phase system, which involves a good deal of complicated apparatus on the car, all of which involves certain losses. He did not think alternating-current motors would replace direct-current motors on city lines, and alternating-current interurban motors which were obliged to operate over direct-current city lines would always be at a disadvantage. The advantages of the single-phase railway motor would be most pronounced on interurban lines with heavy traffic and on electrically-equipped steam roads. President Henry, who is also president and general manager of the Indianapolis & Cincinnati Traction Company, said that as yet his company is operating only one car, and that within the City of Rushville to conform to the terms of a franchise. In another week he hoped to have a number of miles of interurban line in operation, and it would probably be 30 days before the entire line from Indianapolis to Rushville would be in operation. As to the merits of the single-phase system, he wished to put himself on record as believing that the time will come when electric interurban roads will handle heavy freight and lots of it, and he believed that the single-phase system would make this possible. The Indianapolis & Cincinnati cars will be equipped with two trolleys, one being of the ordinary wheel type for use in the city of Cincinnati, and the other of the bow type for use on the high-tension line outside the city. Power is to be transmitted from the power station to sub-stations at 33,000 volts, where it will be stepped down to 3,300 volts, at which voltage it will be supplied direct to the trolley line. Transformers on the car reduce the voltage to 250 for use in the motors. The transformer sub-stations are fire-proof and designed to operate without attendance, the only automatic circuit-breakers to be those located at the power station.

Statistics of the Telephone and Telegraph Industries.—I.

THE Bureau of the Census has done some important work, but none more so than that connected with the obtaining and publishing of statistics relative to the electrical industry. The bureau has already published some of this work, and has issued the figures of all the great departments of electrical manufacturing, street railways, electric lighting, telephony and telegraphy and municipal telegraphic fire alarm systems. Its report on the mining industry includes also a chapter on electrical development in that field. The preliminary figures have been worked out in careful reports and discussions, constituting a body of literature of unique value and scope in relation to the electrical arts in America. A bulletin has been issued this week belonging in this series and dealing with the data reported for telephony and telegraphy for the year ending December 31, 1902. All of these reports were prepared under the direction of Mr. W. M. Steuart, chief statistician for manufactures. Statistics are shown separately for three classes of telephone systems, as follows:

1. Commercial systems, including all systems operated by individuals, firms or corporations primarily for revenue.

2. Mutual systems, including all systems operated through a mutual arrangement between the persons deriving benefit from the service, primarily for the benefit of the owners, revenue being incidental to the operation of the line.

3. Independent farmer or rural lines having no regular exchange or central; these lines are often operated under conditions similar to those controlling mutual systems.

Mutual systems are frequently the outgrowth of farmer lines and commercial systems are frequently developed from mutual systems.

Telegraph systems are divided into two general classes, as follows:

1. Commercial land telegraph and ocean cable systems, including all systems organized primarily for the transmission of messages for the general public.

2. Railway telegraphs, including all wires owned and operated in connection with a railway system, to subserve its business of a common carrier, or operated by a commercial telegraph company through an arrangement with the railway company along whose right of way the wires are strung, whereby messages relating to the railway business are given preference.

COMPARATIVE SUMMARY—TELEPHONE AND TELEGRAPH SYSTEMS, INCLUDING SUBMARINE CABLE SYSTEMS: 1902.

	Total.	Telephone systems.	Telegraph systems.
Number of systems	4,176	4,151	25
Miles of wire	6,168,836	4,850,486	*1,318,350
Salaried officials, clerks, etc.:			
Number	14,953	14,124	829
Salaries	$11,048,518	$9,885,886	$1,162,632
Wage earners:			
Average number	91,426	64,628	26,798
Wages	$40,246,776	$26,369,735	$13,877,041
Capital stock and bonds outstanding, par value	$510,977,583	$348,031,058	$162,946,525
Common stock	$385,033,601	$269,180,076	$115,853,525
Preferred stock	$6,069,621	$4,869,621	$1,200,000
Bonds	$119,874,361	$73,981,361	$45,893,000
Total revenue	$127,755,574	$86,825,536	$40,930,038
Operating expenses and fixed charges, except interest on bonds	$90,651,707	$61,652,823	$28,998,884
Interest on bonds	$5,461,098	$3,511,948	$1,949,150
Dividends paid	$21,239,412	$14,982,719	$6,256,693
Net surplus	$10,403,357	$6,678,046	$3,725,311
Total assets	$647,676,321	$452,172,546	$195,503,775
Construction and equipment (including telephones)	$523,473,142	$366,561,694	$156,911,448
Real estate	$27,484,669	$22,716,538	$4,768,131
Stocks and bonds of other companies	$35,878,286	$9,938,342	$25,939,944
Machinery, tools and supplies	$10,635,486	$9,689,691	$945,795
Bills and accounts receivable	$33,714,416	$30,629,677	$3,084,739
Cash and deposits	$15,579,224	$12,291,840	$3,287,384
Sundries	$911,098	$344,764	$566,334
Total liabilities	$647,676,321	$452,172,546	$196,503,775
Capital stock	$391,103,222	$274,049,697	$117,053,525
Bonds	$119,874,361	$73,981,361	$45,893,000
Cash investment, unincorporated companies	$6,168,609	$6,161,299	$7,310
Bills and accounts payable	$50,547,584	$44,302,999	$6,244,585
Dividends unpaid	$554,733	$188,067	$366,666
Reserves	$38,889,276	$31,029,628	$7,859,648
Sundries	$1,124,265	$1,124,265	.....
Surplus	$39,414,271	$21,335,230	$18,079,041

*Includes miles of wire operated by Western Union Telegraph Company outside of the United States, but does not include 16,677 nautical miles of cable operated by submarine cable systems.

Although the commercial telephone has developed entirely during the past thirty years, the bulletin shows that it is now of vastly greater importance than the telegraph. The extension of the long-distance service, the introduction of the commercial systems into rural districts, the establishment of independent rural lines, the development of such lines, in some instances, into mutual systems with an exchange and more extensive service, and the rapidly increasing use of the telephone in private dwellings, all point to a growth of the industry that can hardly be realized. In 1902 the wire mileage operated by commercial and mutual telephone systems together constituted 70.6 per cent. of the combined mileage for such systems and commercial telegraph systems, and these same telephone systems gave employment to 70.7 per cent. of the wage-earners, paid 65.5 per cent. of the wages, received 68 per cent. of the revenue, and paid 67.8 per cent. of the expenses. The foregoing table is of unusual interest as summarizing both arts.

This table does not include the statistics for the independent farmer or rural telephone lines or for the telegraph or telephone lines owned and operated by steam and electric railway companies. For these two classes of lines, together with those used in the electric fire alarm and police patrol systems of the various cities, 358,787 miles of single wire were reported, making, with the 6,168,836 miles shown, a total of 6,527,623 miles of single wire used in the transmission of messages, besides the 16,677 nautical miles of cable operated by submarine cable systems owned by American companies. While the total thus obtained contains some duplications due to the use of the same wire for more than one service, on the other hand it does not include wire used for purely private purposes, such as connections between two or more places of business or farm houses which are not of sufficient importance to be classed as farmer lines.

At the census of 1880 the telephone industry was in embryo, few commercial companies being in operation prior to that year. The financial interests represented were relatively of great importance, but the amounts were comparatively insignificant as compared with the totals for 1902. The number of miles of wire in use in 1902 was 141 times, and the number of telephones nearly 43 times, as great as in 1880. The number of miles of wire and the number of instruments operated in 1902 by the independent rural lines, which in 1880 were not in existence, were in excess of the totals for the entire industry in the earlier year.

In 1880 the population of the United States was 50,155,783 and the number of telephones of all kinds was 54,319, giving an average of 923 persons per telephone; the population of continental United States in 1902 is estimated at 78,576,436, and the number of telephones operated in that year was 2,315,297, giving an average of 34 persons per telephone.

Although in some States the mutual systems and the independent farmer or rural lines are of great importance, the proportion of the telephone business transacted by such systems in continental United States in 1902 was very small. The commercial systems numbered 3,157—three times as many as the mutual systems, of which there were 994—and reported nearly all of the wire mileage, telephones and subscribers.

The total revenue of all telephone systems, from operation and all other sources, amounted to $86,825,536, or an average of $37.50 per telephone; of this amount 94 per cent. was derived from actual operation. The total operating expenses amounted to $56,867,062, or $24.56 per telephone; the total net income was $21,660,765, or $9.36 per telephone; and the net surplus for the year was $6,678,046, or $2.88 per telephone.

The strong tendency toward concentration is shown by the fact that although only 194 telephone systems, or 4.7 per cent. of the total number of commercial and mutual systems, operated 1,000 telephones or over, these systems reported 72.5 per cent. of the telephones, 87.5 per cent. of the gross receipts from operation, 89.3 per cent. of the operating expenses, and 57.5 per cent. of the net surplus.

Of the 4,850,486 miles of wire reported by commercial and mutual systems in 1902, 48.9 per cent. was overhead, 34.8 per cent. underground, and the remaining 16.3 per cent. represented circuit miles of wire in overhead and submarine cables.

The commercial and mutual systems reported 2,315,297 telephones as in operation during 1902. Of these 10,361 were public exchanges, 80,870 were public or semi-public stations or telephones used by the general public upon payment of a stated fee, and 2,224,066 were private telephones.

There were 2,178,366 subscribers reported, giving an average of approximately one telephone to each subscriber.

The estimated number of messages or talks during the year over the wires of the commercial and mutual systems was 5,070,554,553; for the 4,985 independent farmer or rural lines no estimates could be obtained. Of the total number of messages reported, 97.6 per

cent. were local, and the remaining 2.4 per cent. were long-distance and toll.

The commercial telegraph messages sent during 1902 numbered 90,834,789, or less than one-fifty-sixth of the telephone messages, and the pieces of first-class mail matter that passed through the mails during the same year numbered 4,611,271,580, or not quite as many as the telephone messages.

Estimating the population of continental United States in 1902 as 78,576,436, there were 34 persons per telephone and 65 messages per person, as compared with an average of 2,190 messages per telephone during the year.

While there has been a wide extension of the telephone service in the rural districts, the industry naturally shows the greatest development in the States having the greatest population, and is carried on to the greatest extent in large cities. Of the 1,051 incorporated places in the United States having a population of 4,000 or over, 1,002 are provided with telephone facilities.

Considering the statistics by main geographic divisions, it is found that the North Central division, which ranks first in population, holds the first place also in the number of commercial and mutual systems, miles of wire, telephones, messages during the year, revenue, expenses and net surplus. Similarly, the States holding the first six places in rank for each of these items are all among the ten which were most populous in 1900—New York, Pennsylvania, Illinois, Ohio, Missouri, Texas, Massachusetts, Indiana, Michigan and Iowa, in the order named. Moreover, every one of these States appears in at least one list, with the exception of Michigan, which ranked seventh in number of messages. Iowa ranked first in number of systems; New York first in miles of wire, number of telephones, revenue and expenses, and Ohio first in number of messages and net surplus for the year.

The returns for the American Telephone & Telegraph Company include the data for 43 licensee companies in whose financial transactions it has a material interest, in many cases owning a proportion of the capital stock sufficient to assure absolute control. The systems operated independently numbered 4,107—3,113 commercial systems and all of the 994 mutual systems. The relative importance of the American Telephone & Telegraph Company's systems is shown by the fact that they reported 69.8 per cent. of the wire mileage, 56.9 per cent. of the telephones, and 60.6 per cent. of the messages reported by all commercial and mutual systems. The number of messages per telephone averaged 2,334 for the American Telephone & Telegraph Company's systems, and 2,000 for the independent systems. The following table bears on these points:

BELL AND INDEPENDENT SYSTEMS: 1902.

	Total.	Bell.	Independent.
Number of systems	4,151	44	4,107
Miles of wire	4,850,486	3,387,924	1,462,562
Number of subscribers	2,178,366	1,222,327	956,039
Stations or telephones of all kinds	2,315,297	1,317,178	998,119
Number of public exchanges	10,361	3,753	6,608
No. of private branch exchanges	7,883	7,266	617
Number of automatic pay stations	32,477	26,573	5,904
Number of other pay stations	48,393	29,083	19,310
Switchboards, total number	10,896	3,820	7,076
Manual:			
Common battery	837	356	481
Magneto	10,005	3,463	6,542
Automatic	54	1	53
Messages or talks during year, total number	5,070,554,553	3,074,530,060	1,996,024,493
Local exchange	4,949,849,709	2,998,344,933	1,951,504,776
Long-distance and toll	120,704,844	76,185,127	44,519,717
Salaried officials, clerks, etc.:			
Number	14,124	10,341	3,783
Salaries	$9,885,886	$7,848,551	$2,037,335
Wage-earners:			
Average number	64,628	46,064	18,564
Wages	$26,369,735	$21,026,257	$5,343,478

The systems controlled by the American Telephone & Telegraph Company operated 69.8 per cent. of the wire mileage and 56.9 per cent. of the telephones reported by all systems; their wire mileage was more than twice as great as that of the independent systems.

The independent systems operated 7,076 switchboards of all kinds, as compared with 3,820 operated by the Bell systems; of the 54 automatic switchboards reported, 53 were operated by the independent systems.

During the year covered by this report there were 5,070,554,553 messages or talks. Of this number, 3,074,530,060, or 60.6 per cent., and an average of 2,334 messages per telephone, were reported by the American Telephone & Telegraph Company's systems, as compared with 1,996,024,493, or 39.4 per cent., and an average of 2,000 per telephone, by the independent systems.

The American Telephone & Telegraph Company's systems reported a far greater number of pay stations than did the independent systems, but the latter operated nearly twice as many public exchanges as the former. The average amount of line controlled per exchange was considerably greater for the American Telephone & Telegraph Company's systems, being 902.7 miles, as compared with 221.3 miles for the independent systems. The following table shows the relative capitalization in 1902 of Bell and independent systems:

CAPITALIZATION OF INCORPORATED COMPANIES, BELL AND INDEPENDENT SYSTEMS: 1902.

	Total.	Bell.	Independent.
Number of incorporated companies	2,271	44	2,227
Capital stock and bonds authorized, par value	$542,633,160	$305,896,400	$236,736,760
Capital stock and bonds outstanding, par value	$348,031,058	$233,270,936	$114,760,122
Capital stock:			
Total authorized, par value	$384,534,066	$264,132,000	$120,402,066
Total outstanding, par value	$274,049,697	$198,298,969	$75,750,728
Dividends paid	$14,982,719	$13,714,437	$1,268,282
Common—			
Authorized, par value	$373,852,341	$261,257,000	$112,595,341
Outstanding, par value	$269,180,076	$198,018,044	$71,162,032
Dividends paid	$14,895,857	$13,711,420	$1,184,437
Preferred—			
Authorized, par value	$10,681,725	$2,875,000	$7,806,725
Outstanding, par value	$4,869,621	$280,925	$4,588,696
Dividends paid	$86,862	$3,017	$83,845
Bonds:			
Authorized, par value	$158,099,094	$41,764,400	$116,334,694
Outstanding, par value	$73,981,361	$34,971,967	$39,009,394
Interest paid	$3,511,948	$1,745,334	$1,766,614
Assessments levied	$137,536	.....	$137,536

The independent systems operated exchanges in all the States and Territories with the exception of the District of Columbia and Utah, and the American Telephone & Telegraph Company's systems operated exchanges in all save Indian Territory. There were 20 States and Territories in which the exchanges controlled by the American Telephone & Telegraph Company's systems predominated, forming 76.2 per cent. of all exchanges operated in these States and Territories.

It is impossible to make an exact segregation of the statistics so as to show the number of lines, the wire mileage and the number of telephones devoted primarily to telephone work in the country as distinct from the urban districts. Approximately, however, there were 21,577 such lines, of which 72.3 per cent. were owned and operated by commercial systems, 4.6 per cent. were the mutual systems, and the remaining 23.1 per cent. were independent farmer or rural lines. The total length of wire was 259,306 miles, or an average length of about 12 miles per line. The total number of telephones was 266,968, giving an average of about 12 telephones to each line and a little less than one mile of wire per telephone. Considering the figures by main geographic divisions, it appears that the North Central States again held first rank. Of the several States, however, New York and Pennsylvania were no longer high in rank, the first five places being divided among the States of Ohio, Indiana, Illinois, Iowa and Missouri, all in the North Central division. Illinois ranked first in number of rural lines and wire mileage, and Iowa first in number of telephones.

The commercial telegraph systems numbered 25 in 1902, as compared with 77 in 1880. This striking decrease is due, however, to the number of consolidations which have taken place, the magnitude of the equipment and business showing a great increase. At the present time the telegraph business is practically controlled by two companies, yet the number of miles of wire in operation in 1902 was more than four times, the number of messages almost three times, and the receipts from messages more than twice, as great as in 1880. The average rate per message in 1902, after deducting the number of cable messages and the receipts therefrom, was 31 cents, as compared with 43 cents in 1880.

The total receipts of the commercial telegraph companies in 1902 amounted to $40,930,038, of which 86.2 per cent. represented the gross receipts from operation. The operating expenses amounted to $26,592,411, the net income to $9,982,004, and the net surplus for the year to $3,725,311.

The commercial telegraph companies reported 1,318,350 miles of wire in operation in 1902, but also made a report of 1,307,046 miles as owned or leased. Of the latter mileage, 62.5 per cent. was operated by the single or Morse system, 14.1 per cent. by the duplex system, 22.6 per cent by the quadruplex system, and the remaining eight-tenths of 1 per cent. by machine or automatic systems.

The commercial telegraph messages sent during 1902 numbered 91,655,287, of which 820,498 were cable messages.

There were 684 railway companies that reported the operation of telegraph or telephone lines in connection with the transportation business. Along their right of way these companies had 1,127,186 miles of single telegraph and telephone wire, of which they owned 21.5 per cent.

Engineers in the Commercial Field.

At the regular meeting of the electrical section of the Western Society of Engineers, held in the Monadnock Block, Chicago, Friday evening, January 13, Mr. Charles A. S. Howlett read a paper entitled "The Commercial Aspect of Engineering." The basis of the paper was well stated in the hint dropped by Chairman Hale in his introduction of the speaker that, while a well-trained engineer may be one who "can do with one dollar what any fool can do with two," if this engineer has no commercial training the chances are great that some commercial man will get 95 cents of the dollar, leaving the remaining 5 cents to the engineer as his reward. Mr. Howlett believed that the training given to students in technical schools was such as to make them unfitted to cope with those trained in the ways of the commercial world and unable to sell their technical services to advantage. The curriculum of these schools embraces too many purely engineering studies, and practically none which teach the student to understand and deal with human nature as encountered in commercial life. The graduate finds that while he has valuable services or has valuable commercial commodities resulting from his labor and training for sale, he does not usually possess the tact or ability to dispose of them at their real value.

Theoretically, the man who creates a machine should rank higher than the one who sells it, but as matters stand at present the commercial engineer, or the one whose business it is to sell the machine, ranks the higher on the commercial basis. Mr. Howlett dwelt for some time on methods employed in selling apparatus, and also on the traits necessary in the man who is so employed. While these traits are largely inborn, he believed that they could, to a great extent, be cultivated. In conclusion, he recommended that the technical schools incorporate in their curriculum in the senior year studies and lecture courses with subjects such as "Many Ways of Securing Attention," "Arousing Interest," "When to Talk Suggestively Rather than Argumentatively," "How to Create Desire," "Auto Suggestion," "Choosing Time of Introduction of Subjects." Such a course, he thought, would help the technical graduate in a great degree to get his just deserts in the commercial field.

The paper resulted in a lively discussion, the general trend of which brought out the fact that the most successful men combine engineering and commercial ability, and emphasized the unfitted condition in which the technical graduate is thrown into the commercial world. The discussion also brought out the requirements necessary to become a successful salesman, particularly of electrical machinery.

Mr. Harold Almert, superintendent of the Cicero Light, Heat & Power Company, agreed with Mr. Howlett in the advisability of introducing into technical schools courses of the nature suggested. He had encountered many good engineers who did not have the ability to present any good idea or scheme, which they might possess, in an intelligible manner to the board of directors or officers of the concern employing them. Others did not possess enough knowledge of human nature to handle men and were, therefore, doomed to individual work.

Mr. Hine, of the Western Electric Company, thought Mr. Howlett's suggestion might help the graduate to begin where others left off, instead of having to find it all out for himself by hard experience. He also brought out several of the requisites of a good salesman and the methods to be pursued.

Mr. W. G. Carleton, of the Chicago Edison Company, thought it would be impossible to educate some men to be anything but pure engineers.

The fact that the salesman will gain nothing in the long run by using untruths was brought out by Mr. W. H. Beattys, of the Cutler-Hammer Company. One sale might be made to a customer by lying, but the chances were great that another one would not be made to the same customer. When customers can be retained, the cost of selling goods is much reduced, and very little is gained if by one sale the customer is lost.

Mr. C. E. De Crow thought that several engineers had seemingly made a failure because they had gone into the sales department of a business without proper preparation. Engineers were sometimes at a disadvantage as salesmen, he said, because knowing the capabilities of their apparatus, and knowing it was not exactly adapted to the work required, they could not put up as strong an argument as would the commercial man, ignorant of technical shortcomings in the apparatus he was trying to sell.

Prof. Brooks, of the University of Illinois, when asked his views, stated he had attended the meeting to get pointers that could be applied at the university. Some steps toward fitting students for sales departments had already been made. Proposals were prepared and students were required to prepare specifications and to argue the strong features of apparatus they were supposed to sell. In connection with this work, they often wrote to the electrical manufacturers for data and prices that they might be able to present a stronger argument. Prof. Brooks recalled the definition of an engineer given earlier in the evening as the man who could do for one dollar what any fool could accomplish for two. He added that a definition for a good salesman might be stated as a man who could sell for two dollars what any fool could dispose of for one dollar.

Mr. Howlett, taking the floor, stated that the discussion had centered mainly on the sale of goods. He had hoped that it would also involve the sale of engineering services, which all engineers have for disposal. The same methods, he said, were employed by those desiring to sell their knowledge as were used when machinery was to be sold.

The next meeting of the electrical section was announced for February 10, 1905, when Prof. C. F. Burgess, of the University of Wisconsin, is to give a paper on "The Present Status of Electric Furnace Working."

The Denver-Colorado Springs Lighting Convention.

Plans that are rapidly being agreed upon in detail will provide the best entertainment ever given a convention in Colorado, for that of the National Electric Light Association, in Denver and Colorado Springs the week of June 6. The committees have advanced so well with their work that they make this promise. A great variety of means for entertaining the convention members and visitors have been suggested. So many have been brought to the attention of the committees that they have happily been compelled to make their work that of selecting rather than seeking means for providing entertainment. Too much junket is pernicious. Members who have written to the secretary and members of the committees have expressed themselves as well pleased with the arrangement that provides a pleasure trip with attendance upon the convention. Friendly rivalry is keeping the Denver and Colorado Springs committees very busy. Each set of men is determined that their city shall make the better showing.

The advertising committee is not depending upon the railroads, as is the case generally. While a great deal of the literature that is being sent out comes from the roads the committee is insisting upon a higher standard than that which usually prevails. An illustration of this is the point that practically all of the cards being sent out are those regularly sold by stationers and curio dealers as souvenirs of the scenic beauties of the State. These cards constitute a good point in the advertising campaign. A valuable booklet that is being prepared for distribution in all parts of the country contains detailed information regarding hotels. The facts and figures are given, so that the prospective visitor will know just what will be the cost to him. Supplemented by the circular that tells about side trips and pleasure resorts, this booklet enables the delegate to determine just what he will do.

On Taxation of Electric Properties.

In his recent message to the Legislature, Governor La Follette, of Wisconsin, devotes considerable space to the taxation of electric light and power properties. The present method of taxation in Wisconsin is based on the gross receipts, which he says is unjust. Those companies whose gross receipts are greater than $500,000 per year pay 4 per cent. of the receipts, while those with a less income pay 2 per cent. He urges that an ad valorem system be adopted, that the property be assessed by the State Board of Assessments, and that the taxes accruing go to the municipal authorities in which the properties are located.

His objections to the present method are based partly on the fact that different companies may be controlled and owned by the same organization, yet by reporting their earnings as separate companies they may obtain the lower rate of taxation.

Meeting of Ohio Independent Telephonists.

A number of independent telephone property owners, directors and officers and members of the Executive Committee of the Ohio Independent Telephone Company, met on January 11 at the Chittenden Hotel, Cleveland, Ohio, to talk over the telephone situation. Mr. F. L. Ream, of Columbus, presided.

From an independent telephone owner's standpoint, according to one of them, the situation in Ohio is satisfactory and the companies are making steady progress. They are, however, fortifying to offset attacks of the Bell opposition and at the same time advance their own interests, and both of these objects were given a substantial shove forward at the meeting.

The competition has reached a very bitter stage, and the independents figure that it is necessary for them to work harmoniously to prevent damages that might result if a general understanding did not exist. They complain that the most recent and at the same time the most unpardonable offense of the opposition has been malicious attacks on the financial standings of several companies and their securities. These reports, many of them in booklet form, have turned out to be boomerangs and instead of doing the intended damage they have resulted in a closer unity of the owners of the company and their friends. For this reason they have not been answered.

These stories, which are pronounced absolutely unfounded as to fact, will probably be passed by as being beneath notice, as the prospective buyers of the securities in question are placed in possession of all the information that they desire before making their investment.

Being home enterprises, they are in a position to secure additional facts or investigate the reports which have been circulated for the purpose of damaging the standing of the independents. The next meeting will be held at Columbus in March.

The Electric Street Railways of Massachusetts.

Some very interesting figures are presented in the annual report of the Board of Railroad Commissioners of the State of Massachusetts in regard to the trolley roads of the commonwealth. The report points out that of 74 operating companies, 30 failed to earn expenses and fixed charges, 25 paid dividends; of the 25 which paid dividends, 14 earned them during the year. Five companies have been in the hands of receivers. The commissioners say: "Our attention has been repeatedly called to the unusual expenses consequent upon the severity of last winter's weather and to the loss of receipts in the summer owing to the coolness of the season. But it is not safe to count upon mild winters and warm summers in this part of the country, and while it is agreed that the past year was an extraordinary one it is plain that the weather did not drive five companies into insolvency and others perilously near it. The evil is more radical. In the early days of the change from horse to electric railway, promotion ran wild with the idea that immense profits were to be realized in the extension of the old and in the construction of new railways as electric roads in any and every direction, that where no business was in sight, it would appear under the creative magic of the electric car.

"The test of this opinion, necessarily a test of years in which novelty disappears, is now practically complete. Experience has shown that with the more expensive roadbed and equipment, the heavier rail and larger cars, there has not been the corresponding and expected development of permanent business. Operating cost, too, in heating cars and in repair and renewal of plant, has proved larger than was expected. With the new accommodation and the nearer approach to railroad conditions has come the increased demand of the public for expenditures in the interest of safety and comfort which had not been counted upon, as for example, in construction of double track, instalment of signal systems, and establishment of waiting rooms. Hurried along by the natural enthusiasm for the new type of railway with its many most attractive features, capital, sometimes deliberately misled, has been invested in undertakings for which there was no sufficient demand and which are now represented by roads run, not only without return upon the investment, but at an actual loss of capital. In such cases the future promises as possible events: the acceptance of an unsatisfactory service as better than nothing; an increase in fares, or the abandonment of the railway."

The dividend showing is of considerable interest: "The total amount of dividends declared the last year was $14,985,815.50—an increase of $1,490,627 over the previous year. Thirty-one of the forty-four corporations declared dividends varying in rate from 1 to 12 per cent., and thirteen paid no dividends. Two companies paid 12 per cent.; three paid 10 per cent.; three paid 9 per cent.; one paid 8¾ per cent.; four paid 8 per cent.; one paid 7 per cent. on common and 6 per cent. on preferred; three paid 7 per cent.; three paid 6 per cent.; one paid 5¾ per cent.; two paid 5 per cent.; two paid 4 per cent.; one paid 3 per cent.; one paid 2½ per cent.; two paid 2 per cent.; one paid 1½ per cent., and one paid 1 per cent. The amount of the capital stock of the thirty-one dividend-paying companies was $235,848,245.70, on which the average rate of dividend was 6.35 per cent."

The report shows for the whole State a single-track mileage of 2,724 miles, exclusive of the Boston subway. The gross assets were $140,843,740, and the gross liabilities $136,049,486, leaving $1,641,386 for sinking and special funds and $3,152,868 for surplus. The total income was $27,759,334 and the total expenditure just $216,383 less. The number of passengers carried was 520,056,511, or 195,917 per mile of main track, and the total car miles run were 107,897,456.

Electrical Engineers of the Times—III.

LAMAR LYNDON.

Mr. Lamar Lyndon was born at Newnan, Ga., and in 1886, at the age of 15, entered the University of Georgia, where he followed the academic and scientific courses and was graduated in 1890 with the degree of Bachelor of Engineering. After a year given to practical work in the Bailey Machine Shops and Foundry at Athens, Ga., he spent a year at Stevens Institute in the study of mechanical engineering, and then took up the study of electrical engineering at Cornell University, where he spent two years.

After leaving Cornell in 1894, Mr. Lyndon became manager of the Athens, Ga., Gas & Electric Company, and the following year went to New York to accept a position in the office of a firm of consulting

LAMAR LYNDON.

engineers. At the beginning of 1896 he went to Japan in the interest of several manufacturers of electrical machinery and while in that country became associated with the American Trading Company, the largest American firm then doing business in the East, of which shortly he became chief engineer. This position he occupied four years, during which time he had charge of the design and installation of lighting, railway and transmission plants in Japan and China. During the latter part of this engagement he was sent on special work to India, the Straits Settlements, Burmah, Java, Egypt and England, and through his sound technical knowledge and his adaptability in meeting the difficult and manifold conditions peculiar to the conduct of affairs in the Orient, he was enabled to discharge the important duty with which he was entrusted in a most satisfactory manner. He was then called to the main office of the company in New York and there served for over a year as its chief engineer, this connection giving him a wide and useful acquaintance with the commercial side of engineering.

In 1900 Mr. Lyndon resigned from the American Trading Com-

pany to establish himself in consulting practice in New York City in connection with general expert work, but specializing in storage battery and alternating-current engineering. Mr. Lyndon has been granted a large number of patents covering a considerable range of subjects. Among these are inventions relating to storage battery auxiliary apparatus and systems of distribution, end-cell switches and train lighting systems, which in one form or another have entered into commercial use. He is also the inventor of an electro-mechanical water wheel governor now commercially manufactured. Mr. Lyndon has, in fact, been instrumental in the development of the product of two large companies.

Mr. Lyndon has contributed largely to the periodical press and is represented in the *Transactions* of the American Institute of Electrical Engineers by a paper entitled "The Comparative Behavior of Floating and Booster Control Batteries on Fluctuating Loads," and also by contributions in the discussion of papers. He is the author of a book entitled "Storage Battery Engineering," which is the first treatise covering broadly the entire range of the subject. This work has had a large sale in this country and also in France, where a translation has appeared. He is a member of the American Institute of Electrical Engineers, the American Electrochemical Society, and the Engineers' Club, of New York City.

CURRENT NEWS AND NOTES.

McGILL UNIVERSITY, MONTREAL, received during 1904 from a friend resident in the United States renewal of his donation of $400 for a fellowship in electricity. Rumor associates this handsome gift with the name of Dr. Edward Weston.

BOSTON MUNICIPALISM.—By a mere two-thirds vote—9—the Boston Board of Aldermen has concurred with the Comomn Council in the passage of the order authorizing the city of Boston to establish one or more plants for the manufacture of gas and electricity, etc.

FRANKLIN INSTITUTE.—At a meeting of the electrical section of the Franklin Institute, Philadelphia, last week, the following-named officers were elected: President, Thomas Spencer; vice-presidents, W. C. L. Eglin and C. J. Reed; secretary, R. L. Binder; concurator, Dr. W. H. Wahl.

AMERICAN ELECTROCHEMICAL SOCIETY.—A joint meeting of the Chemical Section of Franklin Institute and the Philadelphia Section of the American Electrochemical Society was held on Thursday, January 19, at which the following papers were presented: "The Chemistry of Electroplating," by Prof. Wilder D. Bancroft, Cornell University; "Modern Types of Electroplating Machines," by Dr. George P. Scholl, Philadelphia, Pa.

TRYING THREE-CENT FARES.—The innovation in the experiment of the Cleveland Electric Railway Company in three-cent fares for a distance of two miles in the center of the city on the lines of that road is being watched with interest, as it is an important new departure in the rate of American traction fares. The Cleveland Electric three-cent fares will carry passengers only the three-cent fare distance; the regular five-cent fare will carry the regular course.

A NOVEL ORDINANCE.—The following announcement comes from Webster Grove, Mo.: "At a meeting of the Board of Aldermen an ordinance taxing telephone companies was passed. It calls for a license of $25 for the first 50,000 volts and $25 for each additional 50,000 volts." We are glad to see the city fathers so determined to penalize this bad habit of the telephone people. But the license fee should have been higher, corresponding to the voltage, say $1,000. The effect of the ordinance will be watched with breathless interest.

NEXT INSTITUTE MEETING.—The 193d meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh Street, New York, on Friday, January 27, at 8.15 p.m. The subject selected for this meeting is "Central Stations." The following papers will be presented and discussed: "Acyclic (Homopolar) Dynamos," by J. E. Noeggerath, associate, electrical engineer, General Electric Company, Schenectady, N. Y.; "Modern Central Station Design as Exemplified by the New Turbo-Generator Station of the Edison Electric Illuminating Company, of Boston," by I. E. Moulthrop, electrical engineer, Edison Illuminating Compay, Boston, Mass.

ELECTRIC POWER IN SARNIA TUNNEL.—It is stated by a Canadian correspondent that the Grand Trunk Railway Company is seriously considering the adoption of electric locomotives in its tunnel between Sarnia, Ont., and Port Huron, Mich. The proposed change, it is stated, will involve an expenditure of between $300,000 and $400,000. It will be remembered that half a dozen lives were lost in this tunnel a few months ago by suffocation from coal gas, which escaped from the steam locomotive of a train stalled in the tunnel.

NORTHWESTERN CONVENTION.—The annual convention of the Northwestern Electrical Association will be held during the current week at the Hotel Pfister, Milwaukee. Papers are to be read on "Electricity at the St. Louis Exposition," "High-Tension Practice," "Single-Phase Railways and Their Possibilities," "A. C. versus D. C. Distribution," "Economy and Working of the Diesel Engine," "Successful Joint Utilization of Small Water Powers," "Distribution and Dollars," "Motors," "Series Alternating Arc Lamps." There is to be a theatre party on Wednesday night and a vaudeville smoker on Thursday night.

HUDSON RIVER TUNNELS.—The banking house of Harvey Fisk & Sons announce that they have financed the Hudson companies, with a capital stock of $21,000,000, of which $16,000,000 is 7 per cent. preferred, and that all the stock has been subscribed and allotted. The corporation is incorporated at Albany and will build two tunnels under the Hudson River and will connect with Interborough lines. In Jersey City the new subways will serve the terminals of Lackawanna, Erie, Pennsylvania and possibly Jersey Central. A contract has been signed with the Pennsylvania and other contracts are expected.

WATER POWER IN SOUTH FRANCE.—Mr. C. P. H. Nason, United States Consul at Grenoble, France, writes: "The utilization of the enormous power of the mountain streams and glaciers, called the 'white coal,' is year by year attaining larger proportions. The last achievement is the lighting of the entire city by electricity generated 27 miles away. Ornate standards, 30 ft. high, with curving pendants terminating with powerful arc lights, have been erected in the streets, and the full illumination, after a period of testing, is soon to be made the object of a festival night. Sixty dollars is the cost of installing and lighting a single lamp for a year, but the subsequent cost, for lighting simply, will be comparatively small —say one-sixth of the former cost."

AUTOMOBILE CLUB BANQUET.—The banquet of the Automobile Club of America is not to be confused with any other automobile dinner, as it is to be held on Saturday evening, January 21, at the Waldorf-Astoria. The reception will be at 7 o'clock and promptly at 7.30 the guests will be seated. Some eminent speakers will be there, and it is expected that there will be at least 400 guests. The house committee, through its chairman, Capt. Homer W. Hedge, has particularly requested that applications be sent as soon as possible as the arrangement of seats is being made. The club has recently increased its list of active members from five to six hundred, and many are on the waiting list. The new club house, when completed, will probably cost about a half million dollars, and the club expects to have a membership of 2,000. Dr. S. S. Wheeler is a member of the committee dealing with the new club house site, etc.

CENSUS OF MANUFACTURERS.—The Act of Congress in making the Census Bureau permanent directed that it should take a census of the manufacturing business of the United States in 1905. The bureau is now entering on this work. By January 16 nearly 2,500 persons will be engaged in the task. William M. Steuart, head of the division of manufactures, is in immediate charge of it. The bureau hopes to have the statistics in hand by the middle of March. Their compilation and the drawing of deductions from them will occupy a large force of skilled workers during the entire year. Possibly a preliminary report will be ready by May 1. Heretofore manufacturing censuses have been taken in conjunction with the ten-year count of population, and naturally they failed to receive that special attention which such a study demands. About 640,000 establishments are engaged in manufacture and of these some 400,000 may be termed factories in the full sense of the word. The bureau is co-operating in some States with the State Bureaus of Statistics.

CARNEGIE GIFT TO TUFTS.—A Boston dispatch states that Mr. Andrew Carnegie has given $100,000 to Tufts College for the erection of a library building. The gift is understood to be without conditions.

MAGNETIC CLUB.—At the annual meeting of the Magnetic Club of New York, held last week, Col. A. B. Chandler, chairman of the board of the Postal Telegraph Cable Company, was unanimously elected president for 1905.

MARCONI TO WED A PRINCESS.—According to a cable dispatch, Signor Marconi is engaged to marry Princess Ruspoli, youngest daughter of Prince Francesco Ruspoli, of the great Roman family of that name. This has been contradicted.

NEW YORK CENTRAL.—The electrical commission of the New York Central Railroad has just concluded a tour of inspection. The track and electric locomotive and plant at Hoffman's Corners were visited and trips were also made to the General Electric works at Schenectady, the Westinghouse works at Pittsburg and the Bullock works at Cincinnati. The party included Messrs. Bion J. Arnold and Frank J. Sprague.

INSTITUTE PORTRAIT GROUP.—A large portrait group containing the photographs of several hundred members of the American Institute of Electrical Engineers has been made by Barclay Bros., of New York City, and has now been issued with a key. It is a very large picture of great interest, but few prominent members being omitted. Some of the portraits are excellent; others are dismal failures. The average excellence is high. A most striking feature is the youth of the majority of the men included in the group.

NEW YORK WIRE CONDUITS.—A bill has been introduced at Albany providing for the municipal ownership of subways to be constructed in future in the City of New York. The bill is similar to the bill which Senator Elsberg introduced last year and which came near passing. It provides for the separation of the operation and the construction contracts so as to permit of roads being built in sections by contractors submitting the lowest bids, without the city forfeiting the right to control and operate the roads when completed. It also provides for the construction of pipe galleries in the subways to carry electric wires.

N. E. L. A. MEMBERSHIP.—Mr. Dudley Farrand, secretary, reports that the campaign recently inaugurated by Mr. Henry L. Doherty, committee on membership for the National Electric Light Association, is accomplishing the prompt and satisfactory results that usually follow Mr. Doherty's undertakings. Judging from the interest already created and the inquiries constantly received regarding the new classes of membership, this campaign bids fair to carry the membership list rapidly out of the hundreds into the thousands. Mr. Farrand sends long lists of names of new members in all classes of membership.

OHIO ELECTRICAL CONTRACTORS.—The semi-annual meeting of the Ohio Electrical Contractors' Association was held last week at the Hollenden Assembly Hall, Cleveland, Ohio. A lunch was held in the afternoon, after which labor questions, betterment of trade appliances and improvement of conditions were discussed. A banquet was held in the evening, at which there were present as guests many of the jobbers and manufacturers in electrical goods of this city. Thirty-six of the forty State members of the association were present. National Secretary W. H. Morton, of Utica, N. Y., and E. M. Lawton, of Cincinnati, were present. F. C. Werk and A. Oppenheimer, both of Cleveland, are president and secretary of the association, respectively.

GOULD IN VIRGINIA TROLLEYS.—It is announced from Richmond, Va., where he is already heavily interested that Mr. Frank Jay Gould has decided to add about $5,000,000 more to his investments in Virginia. He now controls the entire street railway and lighting properties in Richmond and Petersburg and the interurban line between the cities. His new investment will be the building of a trolley line from Richmond to Ashland, and thence through the fertile and remote territory to the north coast, stretching to the Chesapeake. He will have the terminals on Chesapeake Bay. This system will cover 200 miles and will bring a practically hidden country into touch with all the cities of the East. A charter has been asked for and it is believed that construction will begin in the early spring.

LECTURES FOR TROLLEY MEN.—Prof. Edward F. Taylor, instructor of the electrical class, organized by the Brooklyn Rapid Transit Company's Employes Benefit Association, has arranged for a series of lectures and trips for the employes on successive Monday evenings during the months of January and February. On Monday evening, January 9, an interesting lecture was given by Prof. Sidney B. Ashe, of the Brooklyn Polytechnic Institute, on "Safety Appliances of the New York Subway." On Monday, January 16, Mr. Max Loewenthal, of the Prometheus Electric Company, lectured on "Niagara Power Development," which was illustrated by numerous lantern slides. The three Mondays following will be devoted to trips to the various power houses where the details of the equipment will be thoroughly explained to the employes. This entire feature is arranged so as to entail no expenses on the part of the employees and is highly appreciated by them.

LEWIS AND CLARK EXPOSITION.—One of the proposed novelties of the Lewis and Clark Exposition at Portland, Ore., is the submarine lighting of Guild's Lake. Electrical Engineer Thompson, of the exposition company, has submitted plans which complete the scheme for about 125,000 lights on Columbia Court, the shore of the lake, and alongside the Bridge of Nations. This lake is the largest body of water ever enclosed in exposition grounds, being over 200 acres in extent. The lights will be of 50 cp, enclosed in air and water-tight receptacles. Spectators will thus be able to see fish swimming about in the shallow water. Completing the vista of Columbia Court on the island in the lake will be the Grand Court and gardens in front of the Government Building, surmounted with 300-ft. towers, which, with their outlines trimmed with thousands of lights, can be seen as far as the Cascade Range of mountains, 75 miles distant. In the center of the lake an immense geyser will play, lighted by vari-colored lamps.

NEW YORK TELEPHONE RATES.—The West End Association of New York proposes to urge on the Legislature the enforcement of lower telephone rates. In regard to recent criticisms of the telephone rates in New York, it is stated that the rates are as low as consistent with efficient service under the existing conditions. The schedule has been shaped after a careful study of the situation extended over several years, and as it stands is the product of much reduction and adjustment. The effort has been to give an all-Manhattan Island service at rates equitably apportioned. It is, of course, evident that there are certain expenses which must be met whether a telephone is used or not, and this is sufficient to account for the graduated scale of rates for the different number of calls per year. As for the schedule as a whole, there is probably no place in the world in which a telephone subscriber can reach as many people at so low a rate as in Manhattan Island, where on the first of January there were 152,714 telephones. To any one familiar with the working of a telephone system it becomes very evident after considering this figure that it is next to impossible to compare rates in New York, as a rule, with those of other cities on anything like the same basis.

PROPOSED LIGHTING INVESTIGATION.—The Committee on Gas & Electricity, of the Merchants' Association of New York, has prepared for introduction into the Legislature a joint resolution providing for an investigation of all the conditions surrounding gas and electric lighting in the city and also for an investigation of all the conditions surrounding the operation and control of the electrical subways. Other resolutions addressed to the same subject do not cover the last-named phase, which is considered one of the most essential features of the lighting situation. The memorial which sets forth the reasons for this investigation has been mailed to all the members of the Legislature. The committee, it is proposed, should report on or before April 1 this year, which would apparently leave very little time for all this work. A lot of the figures in the memorial are a rehash of the old falsities and misstatements about electric lighting. For example, "According to the information compiled by the Department of Water Supply, Gas and Electricity, the City of New York pays the electric light monopoly a price for lights which represents a profit of 250 per cent." This is utterly untrue. The department has done no such thing.

NAVAL WIRELESS SYSTEM.—Rear Admiral Manney, chief of the Bureau of Equipment of the Navy, has just completed plans for the system of wireless telegraphy all along the Atlantic Coast. Some of the stations will be 250 miles apart.

NEW FRENCH SUBMARINE.—A cable dispatch from Paris of December 31 says: "The French submarine *Korrigane*, stationed at Bizerta, successfully remained under water twelve hours, from 6 a.m. to 6 p.m. Her motive force is electricity. During the test the conditions of habitability were excellent. French naval men say this is a record."

ELECTRICITY IN ATLANTA.—Mr. T. J. Harper, the city electrician of Atlanta, Ga., reports that no electric fires of any kind or accidents to life from imperfect electrical construction took place there last year. There were 903 public arc lights in use, as well as 31,845 commercial incandescents, 284 interior arcs, 309 fan motors and 136 power motors. Permits were issued for 30 miles of conduit duct.

ELECTRIC LOAN ASSOCIATION. The twentieth anniversary of the Serial Co-Operative Savings and Loan Association, of New York, was celebrated by a dinner at the Hotel Astor, New York, last Tuesday night, January 17. This association, which is the oldest of its kind on Manhattan Island, was organized and has ever since been managed, by employees of the Western Union Telegraph Company. It has assets of over $150,000.

ELECTRICAL FIRES.—Mr. H. J. Blakeslee, the electrical inspector of the Hartford (Conn.) Board of Fire Underwriters, in his annual report, says that the increase in the use of electricity in Hartford during the last three years has been 54 per cent. Out of 231 fires in Hartford in 1904, only 6 were electrical, and the average for three years was only 1.9 per cent. Many of the fires were caused by the carelessness of gas plumbers in handling and tampering with electric lighting circuits they came across in their work.

TELEPHONE RATES.—The New York *Herald* is conducting warfare on the New York Telephone Company, because of alleged high rates, and is encouraging people in chopping down wires and roof fixtures because they do not want to pay bills for service rendered. As a result, telephone service has been badly crippled at times on the upper west side of the city. The wanton damage to fixtures upon which public convenience depends and which have been put up under contract is serious, but the *Herald* glories in its communistic work.

STATE REGULATION OF TROLLEYS.—In his message to the Legislature Governor Johnson recommended that the electric lines of the State be placed under the control of the railway and warehouse commission. Thomas Lowry, president of the Twin City Rapid Transit Company, said he thought it a good idea. "Eventually," said Mr. Lowry, "the State will be grid-ironed with electric lines, a large part of the mileage being outside incorporated cities and towns, and naturally these must come under the control of the State. Perhaps in a few years there will be many such lines constructed."

FISH LOCATED BY ELECTRIC APPARATUS.—Under date of November 7, 1904, United States Consul E. Theophilus Liefeld, of Freiburg, Germany, reports that a German patent has been taken out for an electrical apparatus whereby the presence and extent of shoals of fish can be ascertained. A microphone, enclosed in a watertight case connected with an electric battery and telephone, is lowered into the water. So long as the telephone hangs free no sound is heard, but on its coming into contact with a shoal of fish the constant tapping of the fish against the microphone case produces a series of sounds which at once betrays their presence. The rope attached to the microphone is marked so that the exact depth of the shoal is at once ascertained.

AUTOMOBILISM IN FRANCE.—The Chambre Syndicate de l'Automobile has just made a report to the Council of State on the growth of the automobile trade in France during the last few years which is surprising. For instance, in 1898 French makers delivered 1,850 automobiles; in 1904 they delivered 22,000. The total value has grown from 8,000,000 francs ($16,000,000) in 1893 to 176,000,000 francs ($35,200,000) in 1904. The value of exportations in 1898 was 1,750,000 francs ($350,000); in 1904 it was 74,000,000 francs ($14,800,000). Salaries now paid amount to 80,000,000 francs ($16,000,000). The industry employs 55,000 workmen, 25,000 miscellaneous employes and 20,000 chauffeurs and machinists.

WIRELESS FOR WHITE STAR LINE.—A cable dispatch from London states that a contract has been signed with the White Star Line for the equipment of its vessels with Marconi wireless telegraph apparatus. The first vessel to be installed will be the *Oceanic*, which will leave England toward the end of this month. By this contract the Marconi Company will have included in its system the entire number of transatlantic lines trading between Europe and this continent. Vessels of the following lines are now equipped with the system: Atlantic Transport Line, Compagnie Generale Transatlantique, Cunard Line, Hamburg-American Line, American Line, Red Star Line, North German Lloyd, Allan Line and White Star Line.

RADIUM IN SOLAR PHOTOSPHERE.—Prof. Monroe B. Snyder, director of the Philadelphia Observatory, announces that he has discovered the existence of radium in the solar photosphere, and of radium emanation in the solar corona, and in the auroral streamers of the earth. He also finds that radium and radium emanation, the latter identical with coronium, are widely and correlatively distributed in stars, nebulæ, and very probably comets. He further announces these laws: First, there is universal celestial radioactivity, namely, negative or associative, and positive or dissociative transformation of the elements with accompanying absorption and emission of radiant energy of characteristic frequencies and intensities. Second, maximum radioactivity is critically dependent upon the energy gradient and is, therefore, periodic, and often local in sun, stars, new stars, nebulæ, and comets. Prof. Snyder brings his work this week before the American Philosophical Society.

NEW YORK WATER POWER.—The New York State River Improvement Commission, created under a law passed by the last Legislature, organized last week by the election of Attorney-General Mayer as president. The commission comprises, besides the Attorney-General, State Engineer and Surveyor Van Alstyne, State Superintendent of Public Works Franchot, State Forest, Fish and Game Commissioner Middleton and Wallace C. Johnson, of Niagara Falls, the latter being a civil engineer appointed to serve on the commission. The act creating the commission gave to it the powers of the former Water Storage Commission and also authority to make regulation against the pollution of watersheds of rivers, streams and water bodies furnishing water supplies to cities and villages and authority to regulate the flow of such streams and act on questions of water power. The commission can negotiate for the purchase of private water rights, but is to act only on the initiative of cities, villages, counties or towns or private land owners.

ELECTRICAL WORK IN CHINA.—Mr. G. E. Anderson, United States Consul at Hangchau, China, writes: "Several of the larger mission schools in Mangchau and vicinity are considering the equipment of their schools with small electric light and power plants in connection with gasoline engine power. They are doing this both for the sake of the light and for the means such plants would afford for instruction. The president of one of the academies has asked me to obtain catalogues for such plants, and I will be glad to use any sent me, both with him and with others. Fifty-light or sixty-light plants will probably be about the size needed. The equipment of one or two schools with such plants will lead to the equipment of others, as a matter of course, but the chief importance of the matter is in the fact that these small plants will be object lessons for Chinese business men and officials of what can easily be done in the cities in commercial light plants. Several American electric light people are considering schemes for the establishment of light plants in cities of this province, but so far, among other hindrances, they have lacked the cordial co-operation of Chinese business men. With a few object lessons at hand this backwardness may be overcome. The development of trade in electrical supplies and machinery in this part of China will probably be very rapid when once it is well started, and the field certainly merits the attention of American business men."

Electrical Power from the Welland Canal.—I.

DE CEW FALLS have had "greatness thrust upon them." From time to time during several years news items have appeared relative to a great development of water power at De Cew Falls and its electric transmission to Hamilton, Canada, some 35 miles away. As a matter of fact, the falls are quite innocent of all this, and the water for the power development comes from Lake Erie by way of the Welland Canal.

Beaver Dams Creek is one of the small streams that rise in the high tableland between Lakes Erie and Ontario, and its waters tumble down the escarpment that lies several miles inland from the shore of the latter. Near the brow of this escarpment, at a point about three miles from the small but ancient and interesting city of St. Catharines, the creek is received in a reservoir that has been constructed to supply that city with water. Below this reservoir its overflow follows the old bed of the creek, and in so doing plunges into a deep gorge that the stream has carved out of the escarpment on its way to the lower lake during past ages, much as the Niagara River has done on a far greater scale a few miles to the east. This small overflow from the city reservoir, together with the discharge of a brook that joins the creek a little below the reservoir outlet, is all of the water that passes over De Cew Falls, and in dry summer weather the bed of the stream is bare.

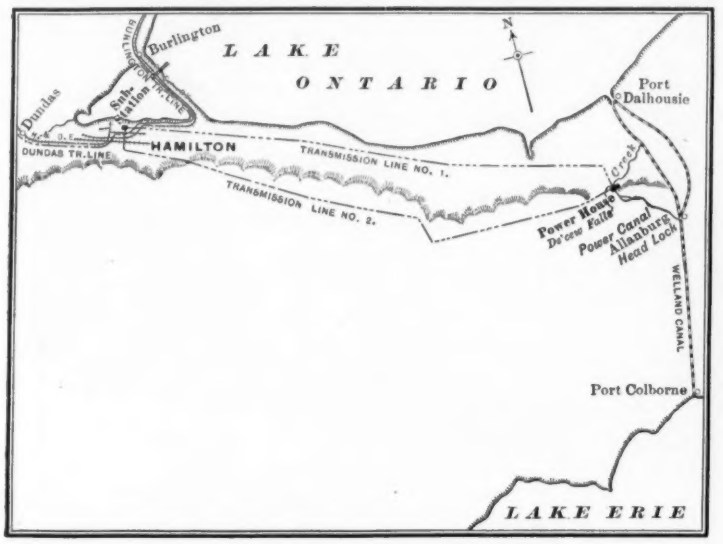


FIG. 1.—MAP OF WORKS, LINES, ETC.

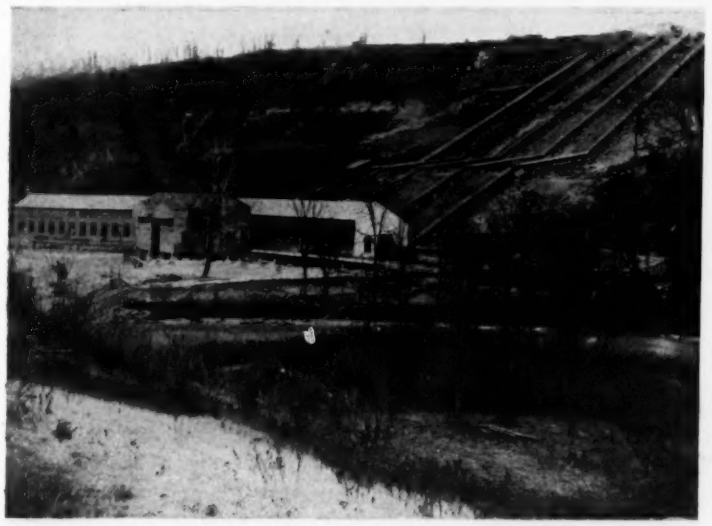


FIG. 2.—PENSTOCKS, POWER HOUSE AND TRANSFORMER HOUSE.

Turning from the mythical water power at De Cew Falls, the real development is found at the foot of the escarpment, on Twelve Mile Creek, a little more than half a mile away. This creek is as free of capacity for power development as the one above named, but its bed is only thirty-odd feet above the surface of Lake Ontario, and thus forms a cheap and convenient tail-race for water from the power house.

Water for this power development is drawn from the old and new Welland Canals close to their point of junction near Allanburg, Township of Thorold, County of Welland, Ont., about four miles distant. All save about 800 ft. of this distance, which represents the approximate length of the steel pipes between the forebay and the power house, is traversed by a canal that widens into reservoirs at several points. During the past year the canal and these storage reservoirs have been much enlarged, so that the latter, which formerly had an area of only 40 acres, now measure 450 acres, and contain 50,000,000 cu. ft. of water. Taking the normal surface of Lake Ontario as zero level, the elevation of water in the power canal at the intake weir is about 325 ft., at the forebay the elevation is 306 ft., and the elevation of the tail water in the creek below the power house is 38 ft. Between the surfaces of forebay and tail water the difference of elevation is thus 268 ft., from which a small deduction must be made for loss by friction in the pipes, in order to get the effective head on the wheels. This hydraulic development has been constructed under the right to draw water continuously from the Welland Canal at the rate of 700 cu. ft. per second during a period of 63 years. The storage basins are designed for a rise and fall of 3 ft. in their water level when in use, and the volume of water that may be drawn from them during a period of heavy load is thus $450 \times 3 = 1{,}350$ acre-feet, besides the constant diversion of 700 ft. per second from the Welland Canal. As one acre-foot equals 43,560 cu. ft., a reduction of 3 ft. in level over the 450 acres of the reservoirs would yield 5,880,600 cu. ft. of water for the power plant, a volume equal to that which may be drawn from the Welland Canal during 23.33 hours.

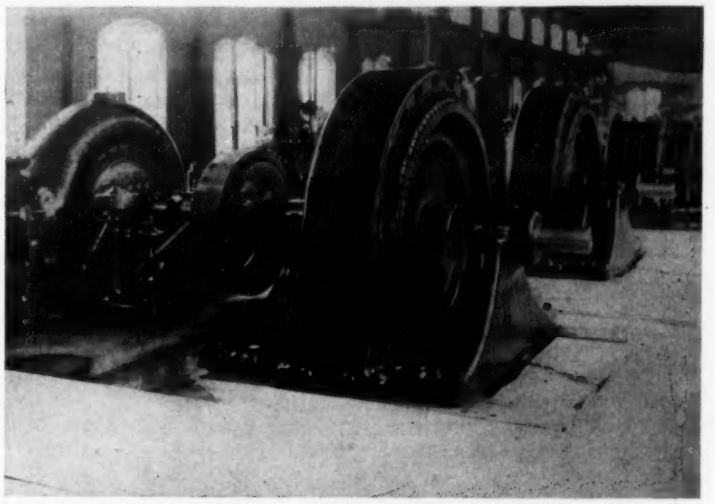


FIG. 3.—INTERIOR OF DE CEW FALLS POWER HOUSE.

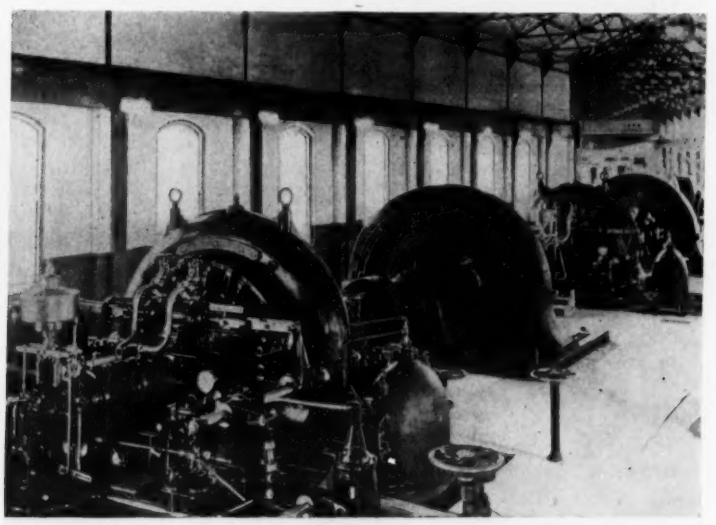


FIG. 4.—INTERIOR OF DE CEW FALLS POWER HOUSE.

Allowing 8 ft. of head for the losses in the pipes and draft tubes

that connect with the turbine water wheels at the power house, so that the effective head is 260 ft., the 700 cu. ft. of water per second that may be drawn from the Welland Canal, at 62 pounds per cu. ft., will develop 20,516 hp. If the turbines have an efficiency of 80 per cent., the allowable draft on the Welland Canal will thus develop about 16,000 hp for electric generators. This output may be multiplied several times by use of the stored water during short periods of several hours each.

The forebay on the brow of the escarpment, some 250 ft. above the power station, terminates in a heavy masonry wall that is pierced by four steel pipes of 6.5 ft. inside diameter each. Provision is also made for two more of these pipes that will be installed later, and each is provided with a head gate. Somewhat more than halfway down the face of the cliff the direction of the pipes changes, so that they make only small angles with the horizontal for some distance, to correspond with a natural shelf of the escarpment. On reaching the power house the pipes pass underneath the main floor, and to water wheels that are arranged in a row along its more distant side.

A. Riva, Manneret make, single-runner, single-discharge type, and each is rated at 286 r.p.m. and 3,300 hp. Each of the other four main wheels was built by J. M. Vaith, of Heidenheim, Germany, has a double runner and double discharge, and is rated at 7,100 hp and 286 r.p.m. For the operation of exciters there are two Stilwell-Bierce turbines, each rated at 800 r.p.m. and 50 hp. A 30-kw Crocker-Wheeler exciter is direct-connected to each of these turbines. All of the above water wheels operate under the approximate head of 268 ft.

To each of the 1,700-hp wheels a Royal Electric inductor alternator is direct-connected, and each of these alternators is rated at 1,000 kw. A Canadian General Electric alternator of 2,000 kw capacity is coupled to each of the 3,300-hp turbine wheels. The 7,100-hp wheels are intended to drive four alternators of 5,000 kw capacity each, and two of these alternators of the Westinghouse make are now in position. All of the alternators just named are of the three-phase type, and operate at about 66 cycles per second and 2,400 volts. The combined rating of the six alternators now in position is 11,000

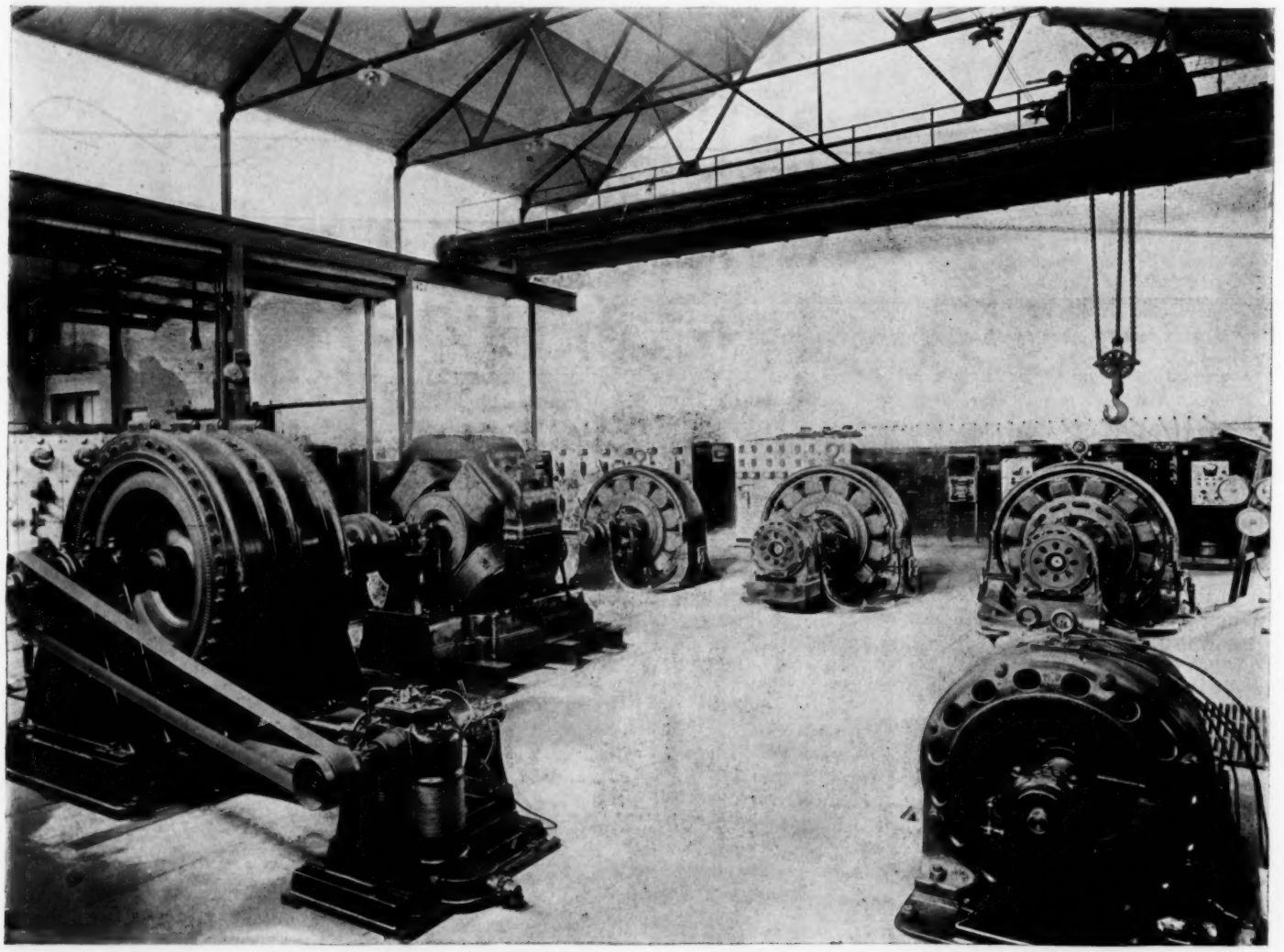


FIG. 5.—MOTOR-GENERATOR SET AND 300-KW ROTARY CONVERTER, SUB-STATION "A."

The power house is a long, narrow, one-story brick building, with its longer sides approximately parallel with Twelve Mile Creek, which serves as the tail-race, and at right angles to the general direction of the steel pipes. Steel trusses support the roof of the station and beneath them a traveling crane sweeps the entire space occupied by the water wheels and electric generators. The wheels and generators are in the same room, each generator is direct-connected to its own wheel, and all of the units thus formed are horizontal and are arranged in a row parallel to the longer sides of the station. At one side of the station is the transformer house, a separate building, where the high-voltage lines that transmit the energy to Hamilton terminate.

Eight main turbine sets are provided for the operation of an equal number of electric generators. Two of these turbines are of the Stilwell-Bierce make, single-runner, single-discharge type, and each is rated at 1,700 hp and 400 r.p.m. Another two wheels are of the

kw, and the other two 5,000-kw generators for which provision has been made will raise this total to 21,000 kw.

Much the greater part of the electric energy developed at this water power station is raised to 22,500 volts and transmitted to Hamilton, 34 miles away, but a portion of it goes to the city of St. Catharines, about three miles distant, at the generator voltage of 2,400 for electric supply there. In the transformer house at the generating station there are at present 25 transformers for raising the generator voltage of 2,400 to 22,500, or to 45,000 for the transmission. Twenty of these transformers are of Royal Electric make, oil-insulated, water-cooled, and step the voltage from 2,400 to 22,500, three-phase. Ten of these twenty transformers have an individual capacity of 200 kw, and the other ten an individual capacity of 400 kw, so that the combined capacity of the group of twenty is 6,000 kw. Five other transformers, also of the oil-insulated, water-cooled type, are of Westinghouse make, are rated individually at 2,500 kw, and

operate from 2,400 volts primary to either 22,500 or 45,000 volts secondary, as desired. For these five transformers the combined rating is 12,500 kw, so that the total capacity of transformers now at the water power station is 18,500 kw. To this there will be added five more transformers, each of 3,300 kw rating, oil-insulated, water-

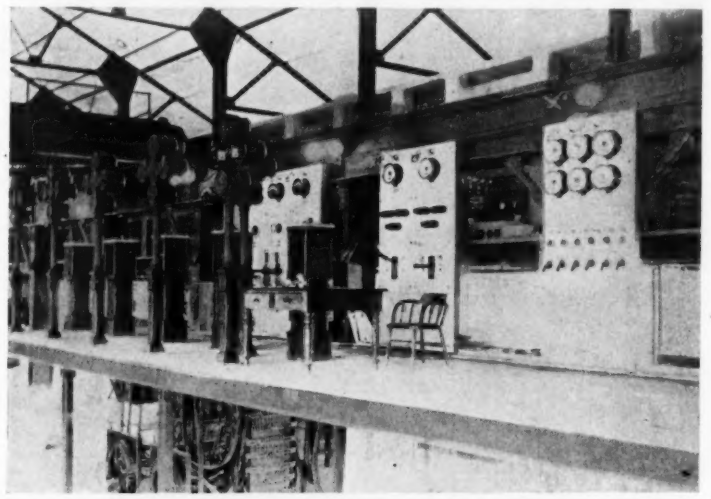


FIG. 6.—SWITCHBOARD GALLERY.

cooled, and working with 2,400 volts primary and either 22,500 or 45,000 volts secondary. These last-named transformers will raise the step-up capacity at the generating station to 29,000 kw. Connections between the generators, the transformers and the transmission lines are made through three-pole, electrically-operated, non-automatic oil switches. Each generator circuit passes through two 1,600-amp. switches of this type, in series. Besides the controlling switches for the power circuits, the switchboard and pedestals carry a full equipment of indicating instruments and recording wattmeters. The oil switches, switchboard and instruments are of Westinghouse make.

Two transmission lines leave the terminal house at the generating station for Hamilton, and each conductor of these lines is connected to a Canadian General Electric air-gap lightning arrester, designed for 22,500 volts, and passes through a choke coil before it reaches the transformers. One transmission line runs from the water power plant to the sub-stations in Hamilton by way of the low, level strip of land that lies between the foot of the Niagara escarpment, or "mountain," as it is called, and the shore of Lake Ontario, and the length of this line is 33 miles. The other transmission line passes from the power station up the face of the escarpment, and then runs along near its brow for nearly the entire distance to Hamilton. By the way of this line the distance between the power house and the sub-station in Hamilton is 34 miles. The maximum distance in elevation between the two lines is about 300 ft., and their greatest distance apart is about 10.5 miles. Each transmission line consists of a single circuit mounted on porcelain insulators and wooden pins, cross arms and poles.

For both circuits the insulator is the same, namely, a two-part, No. 9 S 40,000 type, made of porcelain by R. Thomas & Sons. This insulator has one large petticoat of 9 in. diameter, and a sleeve that runs down 5 in. below this petticoat. At its lower end the sleeve has a diameter of 4.5 in. The total height from the lower edge of the sleeve to the top of the insulator is 8.75 in., and the width of the wire groove at the top of the insulator is 1 in. A special locust pin carries each of these insulators and has a diameter of 1¾ in. in the shank that enters the cross arm, and 2 in. at the shoulder just above the cross arm. As the insulator is mounted, the lower edge of its petticoat is ⅝ in., and its top is 9⅜ in. above the top of the cross arm. The two transmission circuits are arranged quite differently on their poles. The circuit that occupies the low land between the escarpment and the lake, known as No. 1, consists of three stranded aluminum conductors, each having a cross section of about 320,000 c.m. One of these conductors is mounted at the tops of the poles, and the other two are at the ends of a single cross arm, so that the three conductors are at the corners of an equilateral triangle with sides of 45 in. each. For No. 2 circuit, which runs along the top of the escarpment, six copper conductors are employed, three solid and three stranded, and each of these conductors is No. 00. These six conductors are arranged in pairs on three two-pin cross arms, so that there is a distance of 54 in. between each pair and the one nearest to it. Each pair of wires on one of the two-pin cross arms forms one conductor of the three-phase circuit. Before the aluminum conductors were erected the six copper wires that now form one circuit were run three on each pole line, and then

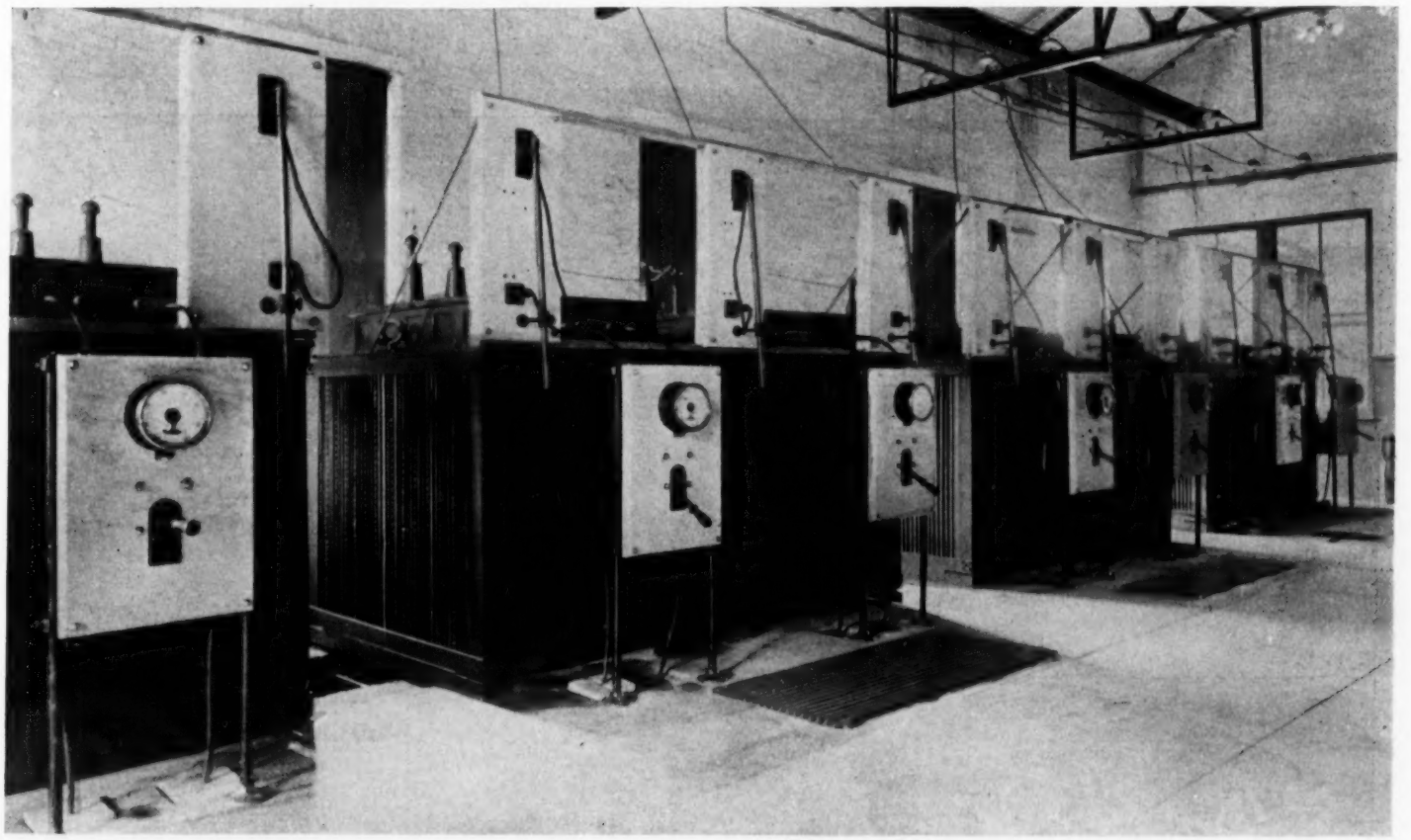


FIG. 7.—500-KW STEPDOWN TRANSFORMERS, SUB-STATION "A."

served as two independent circuits. In the past the voltage of transmission has been 22,500, but it is the intention to raise it to 45,000 in the near future.

Energy brought by these transmission lines is delivered in Hamilton at two sub-stations, known as "A" and "B," respectively, and also at two smaller sub-stations in the towns of Grimsby and Beamsville. Sub-station "A" is located on Victoria Avenue North and is distant about 1¼ miles from the City Hall and business center of Hamilton. This sub-station is also on the line of the Grand Trunk Railway, so that its coal supplies are received directly from the cars. In structure the sub-station is a brick building with concrete floor and steel truss roof, and is one story in height. Some changes are now going on in the equipment of this sub-station and when these are completed the apparatus there will be as stated below. On entering the building both of the transmission circuits are provided with choke coils and General Electric air-gap lightning arresters before going to the transformers. The 20,000 or 40,000-volt, three-phase current from the water power plant is received at sub-station "A" by 23 transformers that lower the pressure to 2,400 volts, two-phase. Fifteen of these transformers are of Westinghouse make, 20,000 or 40,000 volts primary and 2,400 volts secondary, and each of these is rated at 500 kw, so that their combined rating reaches 7,500 kw.

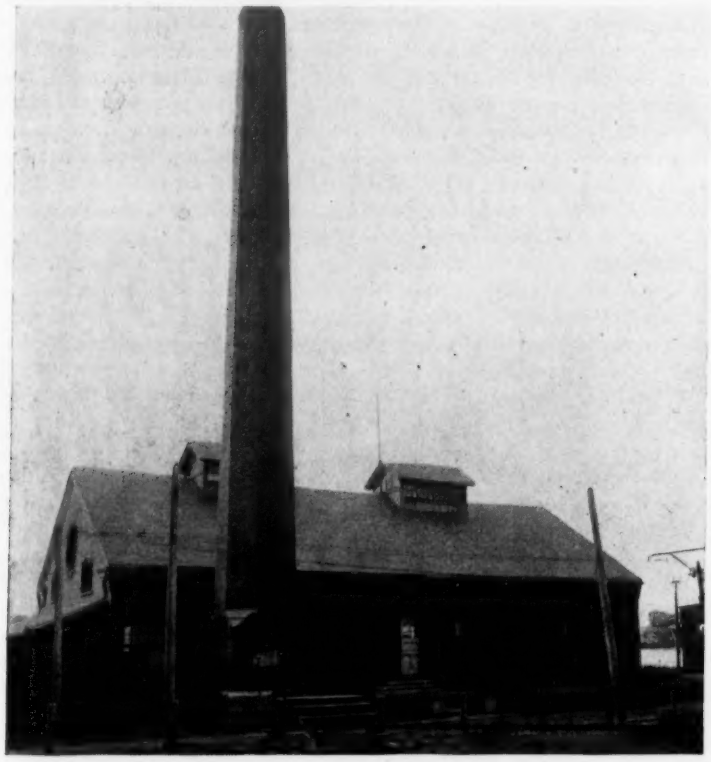


FIG. 8.—EXTERIOR OF BEACH STATION.

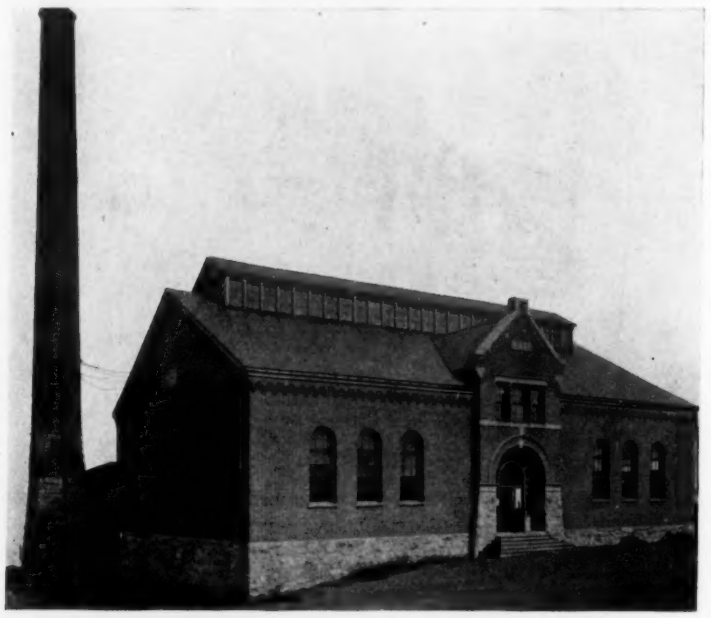


FIG. 10.—EXTERIOR OF GUISE STREET STATION.

The remaining eight step-down transformers at this sub-station are of the Royal Electric make, 20,000 volts primary and 2,400 volts secondary, and rated at 175 kw each, so that their combined rating amounts to 1,400 kw. For the entire number of 23 step-down transformers the combined rating is thus 8,900 kw. All of these transformers are oil-insulated and self-cooling. Each of the 500-kw Westinghouse transformers is of rectangular shape and at one of its sides there is mounted a marble panel with ammeter and a four-pole, oil-break switch for the 2,400-volt winding. The high-tension,

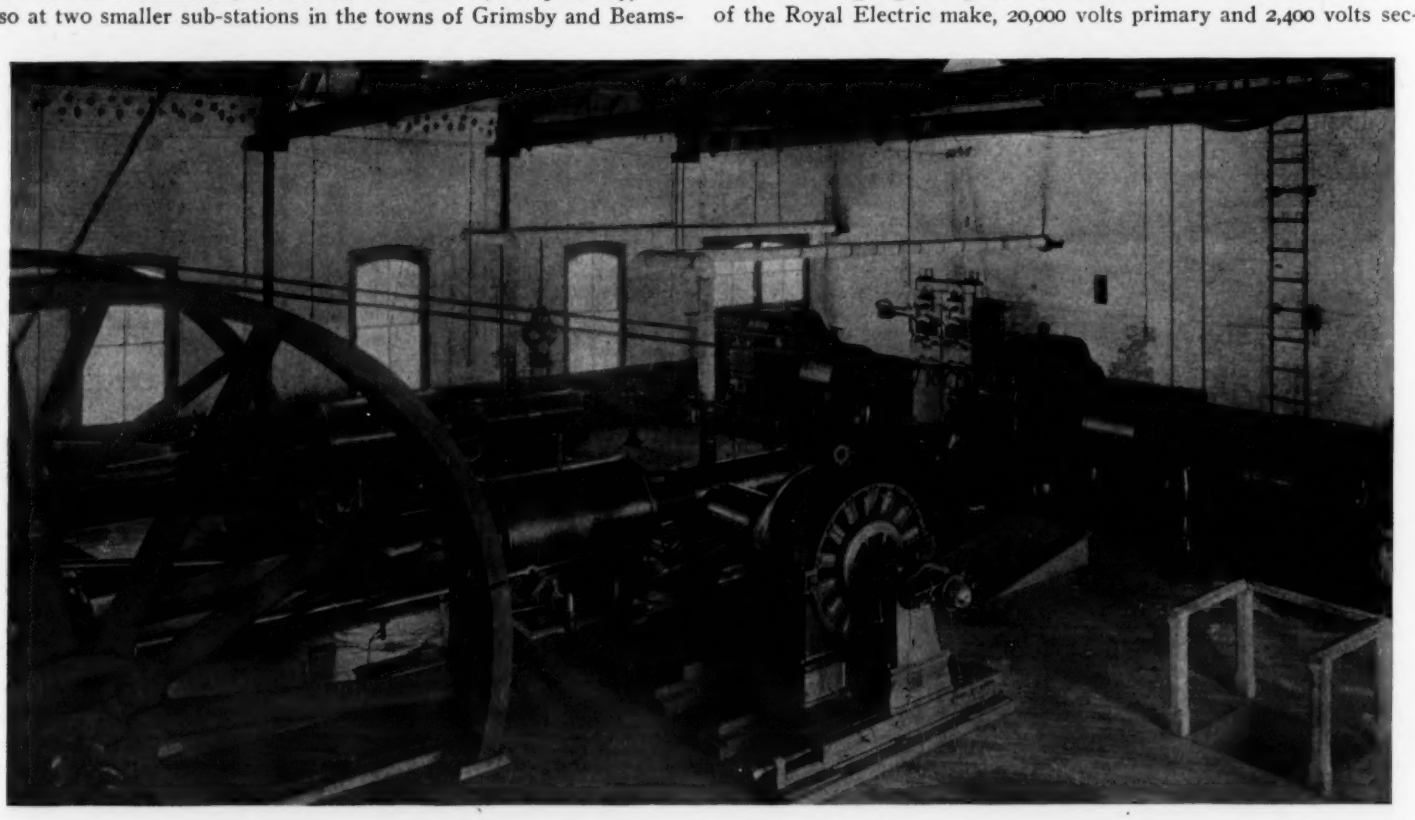


FIG. 9.—INTERIOR OF BEACH STATION.

three-phase circuits are run some feet above these transformers on line insulators that are supported by cross arms beneath the roof trusses. The primary windings of each of these transformers are connected to the transmission circuit through long-break air switches mounted above it, but not intended to open under load. From the foregoing step-down transformers a part of the 2,400-volt, two-phase, 66-cycle current goes to four Canadian General Electric, constant-current transformers rated at 8,000 volts and 7 amp. each on the secondary side. These transformers operate about 450 series enclosed arc lamps on the city streets. A motor-generator for the operation of direct-current elevator motors about the city is made up of a two-phase, 2,400-volt, Royal Electric synchronous motor of 240 kw rating direct-connected to a 200-kw, 500-volt generator made by the Canadian General Electric Company. From this, motor-generator current at 250 volts is supplied to elevator motors by means of a balancing set and a third wire. Current for street car motors is developed at this sub-station by three rotary converters of Westinghouse make, each of which is rated at 300 kw, 600 volts, 66⅔ cycles and 667 revolutions, two-phase. These converters draw their energy from transformers whose primary windings are connected to the 2,400-volt bus-bars. With these converters there is connected a storage battery of 255 cells that have a discharge capacity of 400 amp.-hours.

Besides the above transforming and converting apparatus, sub-station "A" contains two steam-driven generators that are held in reserve for use in case of a failure in the water power or transmission system. Each of these generators is rated at 1,000 kw, 2,400 volts, 66 cycles, two-phase, was made by the Westinghouse Company and is direct-mounted on the shaft of a 28 by 54 by 42-in. Goldie & McCulloch cross-compound engine, that operates at 100 r.p.m. and is non-condensing. Steam for these two engines is generated at 165 pounds gauge by four Sterling water-tube boilers of 500 hp each. With these boilers there is a steam-driven equipment for induced draft built by the Buffalo Forge Company. For the 2,400-volt, two-phase, the series arc, the 500-volt, direct-current and the 600-volt railway circuits that leave sub-station "A" there are switchboards with the usual equipments.

Sub-station "B" contains only transformers with the necessary switches and instruments. This sub-station is designed for an ultimate capacity of 12,000 kw in 24 tranformers rated at 500 kw each, but the present equipment is limited to 12 of these transformers with a combined rating of 6,000 kw. These 12 transformers are of Westinghouse make, oil-insulated, self-cooling and operate from either 20,000 or 40,000 volts primary, three-phase to 2,400 volts secondary, two-phase. With the 8,900 kw of transformer capacity at sub-station "A" and the 6,000 kw at sub-station "B," the total rating of the step-down transformers in Hamilton reaches 14,900 kw. Sub-station "B" is located at Irondale, a suburban section of Hamilton, on Burlington Bay, and about three miles from the city hall. Within a mile of this sub-station is the great plant of the International

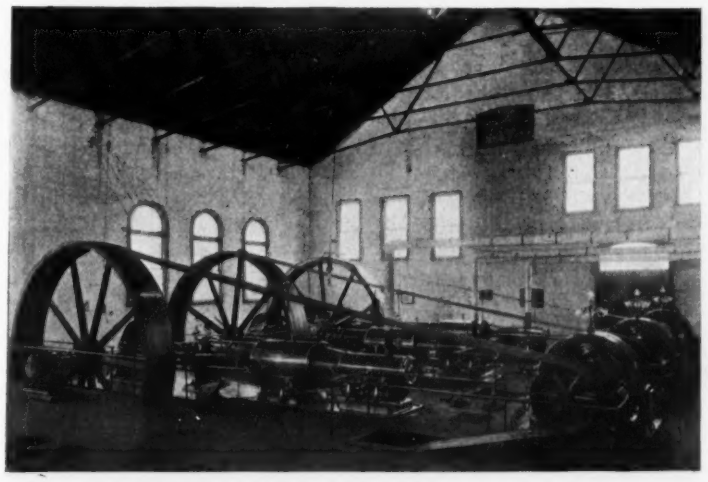


FIG. II.—INTERIOR OF GUISE STREET STATION.

Harvester Company and several of the other factories that are operated by the transmitted current. Sub-station "B" is a one-story brick building with concrete floor and basement.

On their way from the water power plant to Hamilton the transmission lines connect with small sub-stations in Grimsby and Beamsville. At the former place the step-down equipment consists of two 150-kw transformers, cooled by air blast, that operate between 20,000 volts, three-phase and 2,400 volts, two-phase. Connected with these transformers is a 300-hp, 2,400-volt, two-phase induction motor, direct-coupled to a 250-kw, 600-volt Canadian General Electric generator that supplies current for the Hamilton, Grimsby & Beamsville Electric Railway. In the sub-station at Beamsville are two 25-kw, 20,000 to 2,400-volt transformers for the supply of lighting service in that town.

Besides the sub-stations "A" and "B" in Hamilton, there is a steam power station at Guise Street, on Burlington Bay, that contains

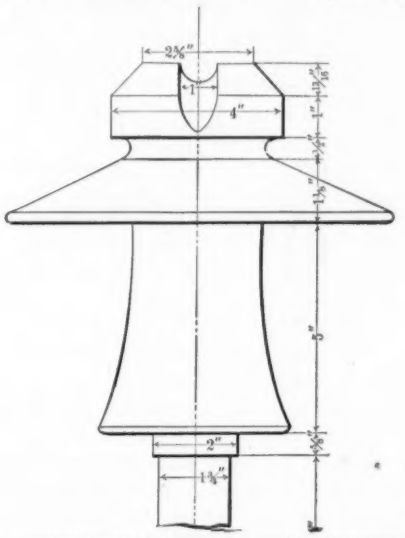


FIG. 12.—INSULATOR HAMILTON TRANSMISSION LINE.

three generators rated at 250 kw and 600 volts each, for the street railway. Another street railway steam station is located at Hamilton Beach and contains direct-current generators of 500 kw combined capacity. Both of these steam power stations are now out of regular use and are held in reserve as security against any failure of the transmission system.

Current for the electric railway in Hamilton, the line to Hamilton Beach and the Hamilton & Dundas Railway is now supplied by the three converters of 900 kw combined capacity in sub-station "A." Electric supply at Hamilton Beach and in Burlington is delivered by 2,400-volt lines from sub-station "B" and lines of equal voltage from sub-station "A" furnish light and power in the town of Dundas.

Electric Power In French Gas Works.

Electric charging machines are now employed for coke ovens and also in modern steel plants for charging Siemens-Martin open-hearth furnaces both in America and in Europe, resulting in the saving of a great deal of labor and economy of operation. The accompanying illustrations and drawings show the kindred construction and

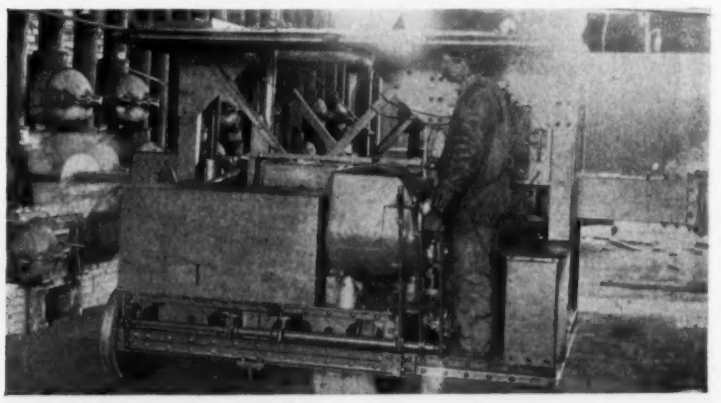


FIG. I.—MACHINE FOR REMOVING COKE FROM GAS RETORTS.

methods of operation of electrically-operated machines for charging the retort of large French gas works with coal and for removing the coke at the proper time. Two types of machines are illustrated, one type being that of the Compagnie Parisienne du Gaz and the other that of Sautter, Harle & Cie.

The electrically-driven machines for removing the coke as well as

the machines for charging the retort move along the tracks provided in front of the gas retorts and receive current from overhead conductors or trolley wires. The coal is deposited at the storage pile and removed therefrom by cranes and cars; and is dumped into the hopper of the electric charging machine. The charging machine is then moved along the track to the retorts to be charged by an electric motor connected to the axles of the charging machine through gearing, the motor being controlled by one of three levers in front of the operator. These electric charging machines were designed for use with long horizontal retorts of 6 meters or more in length.

The hopper or feeding box is arranged with four compartments holding about 4,200 kg. of coal. At the bottom of the hopper or feeding box there are four Archimedes screws arranged 90° apart and the coal is carried by them to the center in a constant stream through a telescopic pipe to a turbine .70 meter in diameter, which is provided with five blades or paddles of steel. This turbine is operated by an electric motor at a speed varying from 430 r.p.m. to 230 r.p.m., the coal being carried in a steady stream through a horizontal pipe or channel into the retort. In order to insure a proper distribution of the coal in the retort, a higher speed is utilized when beginning the charge, as the force of projection required is considerably greater to carry the coal to the ends of the retorts, which is 6 meters long than to deposit it at the entrance; and the speed is gradually reduced to the latter amount above mentioned at the end of the charging.

The speed regulation during the charging is rendered absolutely automatic by means of rheostats connected by gearing to a time commutator, the diameters of the gearing being in proper ratio for a given charge of coal and a given time. The time commutator and rheostats are connected so that the movements are asynchronous, the weight and duration of the charge determining the ratio of the three-toothed wheels connecting the rheostat and commutator. For uniformly distributing 450 kg. of coal in 10 seconds in a retort 6 meters long the energy required for one motor is about 12 hp and for the other about 18 hp.

All of the operations of the charging car are controlled by the operator by means of the three levers noted in the illustration. The pipe or channel connecting the mouth of the retort to the turbine includes two parts, one of which is movable and the other fixed. There are two electric motors utilized, one of which operates at a speed of 900 r.p.m. and moves the turbine up or down for the distribution of the coal in the retorts at various heights. This motor is mounted upon a movable frame which supports the turbine and through conical gearing. The power of the two motors varies according to the length of the charge, electric power being utilized for moving the machine on the track, for operating the turbine in distributing the coal, for raising and lowering the turbine, and for operating the four distributing screws. The latter have a common movement by means of conical gearing, the power being supplied through a sprocket and chain in the case of the charger of the Compagnie Parisienne du Gaz. In the charging machine of Sautter, Harle & Cie the distributing Archimedes screws are not operated by a sprocket and chain as in the case above mentioned, but by gear wheels and pinions; and the arrangement of the electric motors for travel and for operating the turbine as well as for raising and lowering the same are somewhat different. When the turbine has been raised to the proper height for charging a given retort and the motor is started for distributing the coal in the retort, the remainder of the action is entirely automatic, the motor stopping itself at the proper time, taking about 30 seconds to load a 6-meter retort.

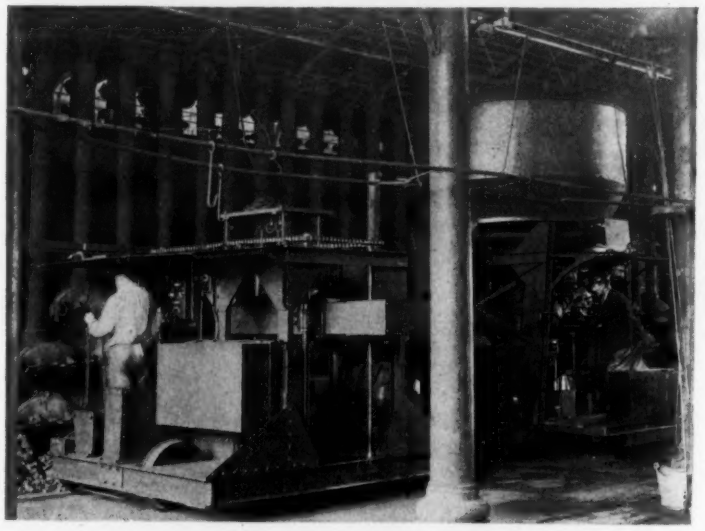


FIG. 3.—COKE-REMOVING MACHINE.

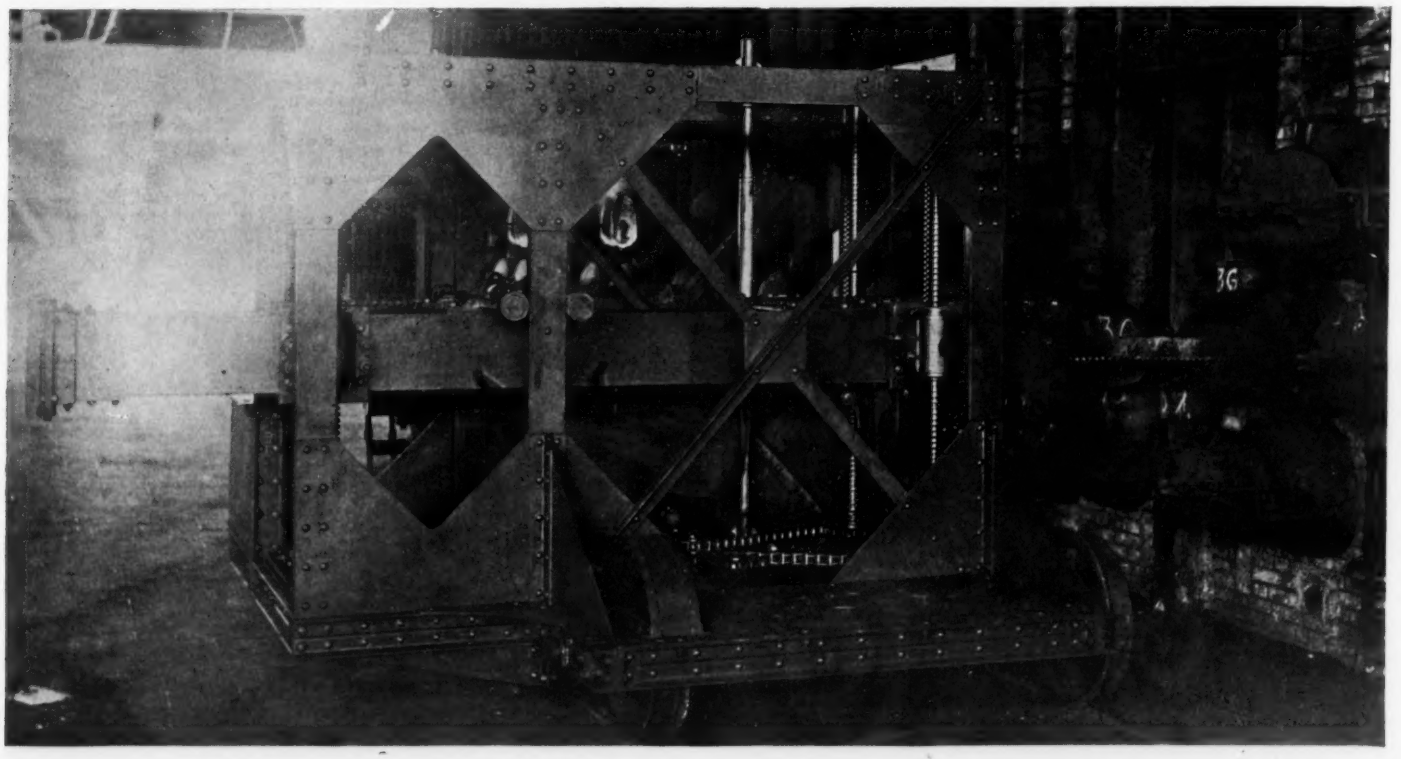


FIG. 2.—MACHINE FOR REMOVING COKE FROM RETORTS.

For removing the coke from the retorts another type of machine is employed shown in the accompanying illustration. It is provided with a telescopic bar arranged in three parts having a head plate or hoe at the end which corresponds in size to the section of the retort, but is somewhat smaller. The telescoping bar is of box section and is operated by an electric motor of 12 hp capacity having a

speed of 900 r.p.m. The operator from the controlling position is provided with three levers for causing the machine to travel on the track, to raise the bar as well as to withdraw by its means the coke from the retort. The levers are connected to friction clutches with the various gearing to transmit the power from the electric motors at the proper time. The bar for withdrawing the coke is designed with three telescoping parts operated by the electric motor through gearing and is provided with a spring brake to deaden the shocks produced by the telescoping under load. The machine for withdrawing the coke is very compact and occupies a space in front of the retorts of not more than 3.7 meters.

It is stated that by the use of these electric charging machines, as well as the electric machines for removing the coke from the retorts, there has been an enormous saving in the operating expenses for this class of work, and the economy of these electric labor-saving devices and methods of operation has been thoroughly demonstrated.

An American-Built Holland Electric Railway.

The cosmopolitan spirit entering into modern business affairs is well illustrated in the case of an electric railway recently built to connect Amsterdam and Haarlem, Holland. The concession was secured by a firm of Hollanders, Messrs. Anderhagen & Neumeyer, and the matter presented to an American syndicate headed by H. J. Pierce, of Buffalo, which after full investigations, decided to furnish the funds to build and operate the line. The Electric Railway Company of Amsterdam was then incorporated in Holland, the shares of which were purchased by the Netherlands Tramway Company, of New Jersey, which numbers among its directors Messrs. W. Caryl Ely, W. B. Rankin and J. G. White. Contracts for the construction

FIG. 1.—EXTERIOR OF POWER STATION, HAARLEM.

of the road were entered into with J. G. White & Co., Limited, of London, England, the electrical generating equipment was supplied by the French Westinghouse Company, the motors by the former German branch of the General Electric Company, the Christensen air brakes by R. W. Blackwell & Co., of London, an automatic block signaling system by the Siemens-Schuckert Company and the cars by a Belgian company.

To secure satisfactory terminal facilities at Haarlem, the local electric road at that place was purchased and an arrangement made whereby running rights were secured over the Amsterdam tramway system from the city limits for a distance of about a mile to a central point within the city. The road is constructed on the main highway to a distance of two miles from Amsterdam, where the line runs over a private right of way. This strip is wide enough to permit of a row of building lots on each side of the track, together with driveways and sidewalks.

The contract with the J. G. White Company covered the complete design and construction of all the work required, including the track and overhead construction, power station, car house, shops, office buildings, bridges, etc., for the Amsterdam-Haarlem interurban line and the reconstruction and additions required by the Haarlem local line. This reconstruction also included the double tracking of the line running from Haarlem to Zandvoort, a sea resort, with which the company had made through running arrangements. The oper-

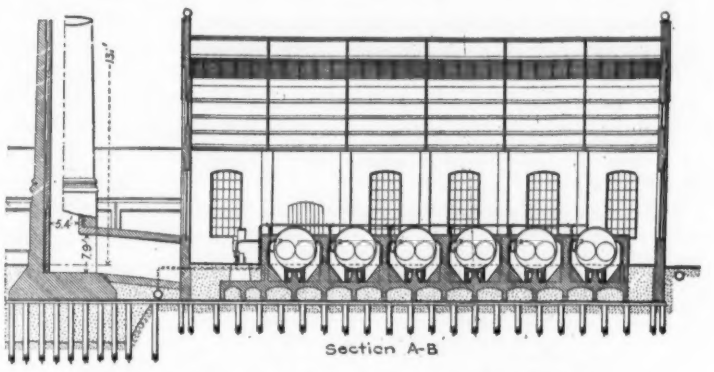


FIG. 2.—LONGITUDINAL SECTION OF POWER STATION.

ation of the completed system was commenced in October, 1904. When the work was at its height on the entire line, there was in use 2,360 laborers, two steam locomotives, one electric locomotive, thirty-one steam pile drivers, three steam spouters, one steam crane, sixty hand pile drivers, one steam bucket rigger and 165 flatboats and scows.

The overhead equipment is on the bow system, the voltage being 500 to 575. The feeder cables consist of bare copper conductors. On that part of the route from Haarlem to Zandvoort bow contact is made with two wires simultaneously. The trolley wire is zig-zagged in order to equalize the wear on the bow. The height of the wire from the ground varies in Amsterdam, on the Government highway and on the Haarlem section. This variation in height caused at first considerable trouble with the bows, but at present the bow base is so arranged as to keep an equal tension on the bow at the respective heights. The wire is screwed and held up by mechanical clips, which, with the bow, gives noiseless running.

The power house is situated in a central position at Halfweg, midway between Amsterdam and Haarlem. It is in practically the best position for distributing power to the line, being located on the banks of the Ringvaart Canal, which will afford cheap carriage for coal and other supplies, and has an abundance of water for feed to boilers and jet condensation. Owing to the nature of the country and the poor condition of ground at the site of the power station, an elaborate arrangement of piling was necessary for the foundations.

The generators, made by the Société Anonyme Westinghouse, are three in number, coupled to condensing Belliss engines. The output of each direct-current, compound, six-pole machine is 300 kw, at

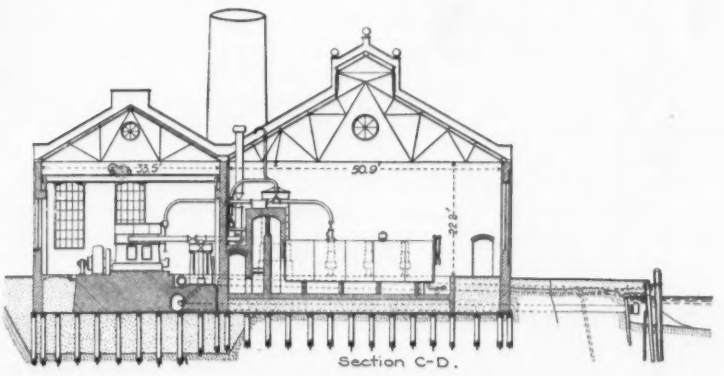


FIG. 3.—CROSS-SECTION OF POWER STATION.

525-575 volts, when running at a speed of 375 r.p.m. The switchboard, which was also supplied by the Société Anonyme Westinghouse, consists of five panels (three generating, two feeder panels), and is situated on the floor at the end of the engine room. The panels are of marble fitted to a steel frame, and having the usual standard forms of instruments, switches, etc. The cables from each of the generators are led into a trench which runs along the ends of the

generators and terminates behind the switchboard. The trench is 15¾ in. wide and covered by chequered plates.

A 14-ton overhead hand traveling crane spans the engine room, the span being 32 ft. 4 in. The motions hoisting and traveling, both longitudinally and transversely, are worked by means of band chains from the engine room floor.

Wherever cars going in both directions use the same single track, automatic block signals have been installed. The signal system includes a contact switch supported in the overhead line near the entrance and exit of each turn-out, designed to be operated by the trolley wheels of passing cars. There is also a counting device which automatically counts cars in and out of the block, whereby, if it is desired, two or more cars going in the same direction can follow into the block, and the signals will not return to clear until all the cars have passed out.

When the overhead contact switch is actuated by a passing car, contact is made with the trolley wire and current flows for a brief

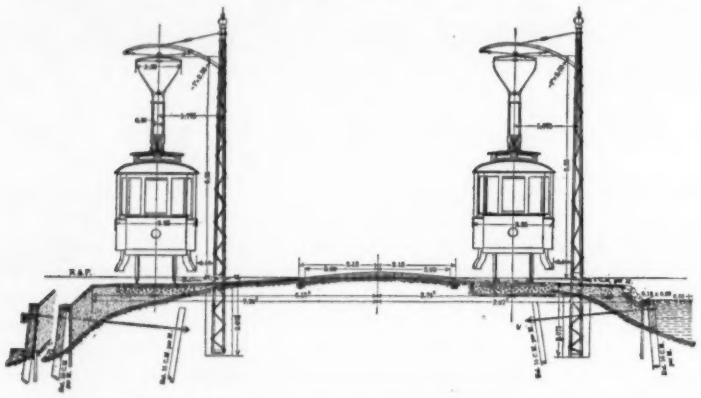


FIG. 4.—CROSS-SECTION OF TRACK ON GOVERNMENT HIGHWAY.

period through the signal system. This current passes through the windings of an electromagnet, whereby the armature of the magnet is drawn up, and a ratchet is engaged with a toothed wheel, and at the same time this wheel turns through one section of its circumference. Attached to the toothed wheel is a spring contact device which permits current to flow to the green and red lights at both ends of the block. If more than one car enters the block from the same direction the wheel is advanced one tooth for each car and the signal lights remain burning. As each car leaves the section the operation is reversed, the toothed wheel going back one tooth for each car, but the lights remain burning until the last car has left the block, when the light current is broken and the signals return to clear.

A New American System of Wireless Telegraphy.

BY A. FREDERICK COLLINS.

IF a curve was plotted to show the relative activity of inventors in evolving new wireless telegraph systems from the beginning of its commercial inception to the present time, a very steep rise would be found from 1898 to 1902, for it was during that period that nearly all the better known types were devised with the exception of Marconi's.

A second curve to graphically indicate the increased number of patents issued in the class of wireless telegraphy would describe a somewhat different course, for each succeeding year has proven more fruitful in its contributions to the details of the art under consideration.

The patent office, however, bears witness to the fact that improvements covering the entire apparatus, or systems, while not cropping out as rapidly as they did a couple of years ago, are by no means at an end; on the contrary, there is every reason to believe that not only minor portions but distinctive systems will loom up on the horizon periodically for a long time to come, for if there was ever an infant industry the transmission of intelligence wirelessly should be so classified.

Just now another aspirant for honors in the already well-tilled field is James Foster King, of New York City, and I am confident that after my readers have perused the text relating to his work they will agree with me that the designer in question is at least entitled to a place in the front rank of wireless telegraph inventors, for he has produced some exceedingly clever devices entirely different from the orthodox apparatus now in general use.

A comparison of the methods for producing high-frequency oscillation from a low initial voltage will serve to show more clearly how this young inventor has succeeded in producing a radical change in the usual construction of oscillating-current generators. In the earlier forms of such devices it will be remembered that a transformer having an automatic break, i. e., a Ruhmkorff induction coil, was the go-between in the conversion of direct low-voltage and

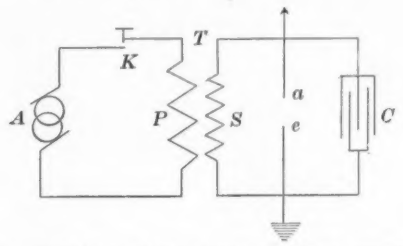


FIG. 1.—ORTHODOX OSCILLATING-CURRENT GENERATOR.

large current strength into high-pressure, small-quantity alternating currents with which the oscillator or radiator system was charged.

Another and more recent plan is the utilization of a source of alternating current coupled in series with the primary of an oil transformer; the secondary terminals are connected in series with a number of Leyden jars, which, when changed to a certain critical value, disrupts the air-gap of a simple oscillator in shunt thereto and electric oscillations are set up as before.

Now, in King's method neither the Ruhmkorff induction coil nor the step-up transformer, nor again the alternating current is required, for his scheme is based on the fact that a condenser may be charged by a direct current, with equal facility as by one having a period of alternation, and that the sudden discharge of a condenser through a circuit having small resistance is always oscillatory in nature.

This novel method of conversion depends primarily for its operation on the great rise in the potential difference between the broken ends of a previously closed exciting circuit which includes an inductance of large value to charge the closed oscillator circuit which is independently connected between the source of excitation and the radiating aerial wire.

To obtain a maximum of sustained current flow in the gap separating the two discharging contacts it is absolutely essential that the exciting energy should be supplied at constant pressure. The transformation ratio between the pressure of the initial current supplied and the resulting potential difference between the ends of the ruptured circuit—as given by the formula, $V'' = V\sqrt{L/I}$, where V is the initial voltage of the generator, V'' the voltage at the terminals on breaking the circuit, I the inductance of the coils, and L the inductance of that part of the helix which is included in the closed circuit—will be considerably greater than that obtained from any

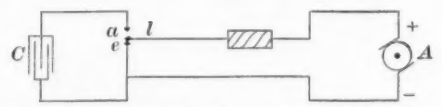


FIG. 2.—KING OSCILLATING-CURRENT GENERATOR.

practical type of transformer of dimensions comparable to the inductance coils which are employed.

By way of comparison, let Fig. 1 represent the regulation type of alternating-current transformer and Fig. 2 a King oscillating-current generator, and let it be assumed that both are excited by a like amount of initial energy. In the first, let us say that the generator furnishes an alternating current of 1,000 effective volts to an iron core transformer whose ratio is $P:S::1:25$, consequently the potential difference between the secondary terminals will be 25,000 volts, which is equivalent to a spark 2½ in. long between points.

If the capacity of the condenser, C, is coupled in multiple with a and e is appreciably large and the inductance of the conductor position of the closed circuit is small, the actual potential difference between a and e, I will be equivalent to $V'\sqrt{L/C}$; as the capacity reaction in this particular instance predominates over the inductance and the transformation will be less than I for all time, as is manifested by the necessary reduction of the length of the gap between a and e, to obtain a spark of any density. In no case where the

capacity reaction predominates in a shunted circuit will the actual p.d. between the discharging points equal the initial voltage.

Now, in Fig. 2 it will be observed there is no extraneous capacity directly connected to the positive wire of the dynamo, *A*, to nullify the inductive value of the d.c. windings and the auxiliary coil *I*, consequently the reaction due to *C* may not be considered until the p.d. between the ruptured circuit is at a maximum which occurs when the approximate resistance of the gap separating *l* from *a* is apparently less than that of *l* to *e*, when the discharge passes to *a*.

When the resistance of the spark between *l* and *a* is decreased by the approach of the said contacts resulting in the final engagement with one another the potential of the charge is increased rather than diminished. In the major number of cases where a spark-gap in series with a condenser is broken down by the initial voltage, the said condenser will receive a potential charge fully twice that of the initial pressure, providing the energy transfer from the electromagnetic to the electrostatic field is not hampered by impedance.

In the King oscillator this energy transfer takes place in air, a media offering a negligible impedance and consequently the resulting potential available for charging the condenser, *C*, will be $2\sqrt{L/I}$ times the initial voltage, *V'*, of the generator. With a generator supplying direct current to a circuit of 5,000 henries inductance the resulting pressure available for charging the condenser, *C*, will be $1{,}000 \times 70.71 \times 2 = 141.420$ volts.

As the current flow per one-fourth oscillation through any portion of a closed oscillating circuit depends conjointly on the apparent

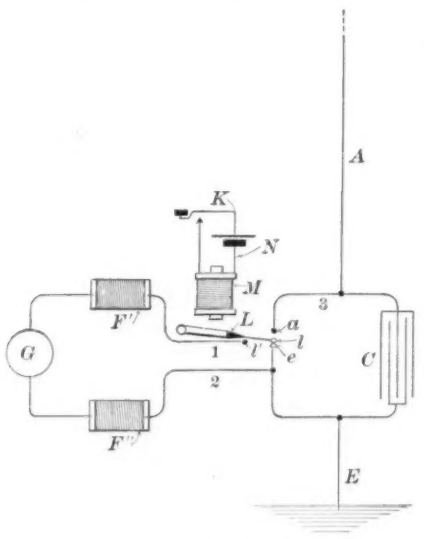


FIG. 3.—KING TRANSMITTER.

cap. ity of *C* and the charging potential between *l* and *e*, it will be seen that the charge given the condenser, *C*, by King's method of direct-current excitation is considerably greater than that which could be obtained by the regulation type of oscillating-current generators having similar capacity.

The theory as detailed above, together with the following description and diagrams makes it easy to understand the practical working of the transmitter. Fig. 3 is a diagram illustrating a simple form of King's transmitter, Fig. 4 is a modification in which the circuits are more accurately tuned, while Fig. 5 shows the final form the tuned transmitter has assumed.

In these drawings *C* represents a condenser connecting the conductor, 3 (Fig. 3), or coil 3' (Fig. 4), and the lever, *l*, carrying the movable sparking contact in multiple with the stationary spark contacts, *a* and *e*, and so forming, through the medium of the spark-gap, a closed oscillating circuit on either side of which are attached the radiating aerial, *A*, and the earthed terminal, *E*. The lower end of the aerial is connected directly to one end of the closed circuit which terminates in a spark contact, *a*, which King prefers to have in the form of a ball having a small superficial area; this contact in the case shown is fixed. The opposite end of the closed circuit is connected to earth and terminates in the contact *e*, the surface of which is larger than the contact *a* and usually flattened on its upper surface; the contact, *e*, in the case shown, is also fixed.

The energy which is converted into oscillations in the closed circuit is obtained from the d.c. dynamo, *G*. The terminals from this generator are connected through the self-induction coil, *F*, *F'*, conductors 1, 2, which are in turn connected respectively to the charging lever, *L*, and the earthed side of the closed circuit. The charging lever, *L*, is mechanically connected to a pivoted armature of an electromagnet, *M*, and carries at its free end the sparking contact, *l*.

The charging lever is operated by the electromagnet through the medium of the battery, *N*, and telegraph key, *K*. Contact, *l*, will be rapidly drawn to *a* when the circuit of the battery is closed by

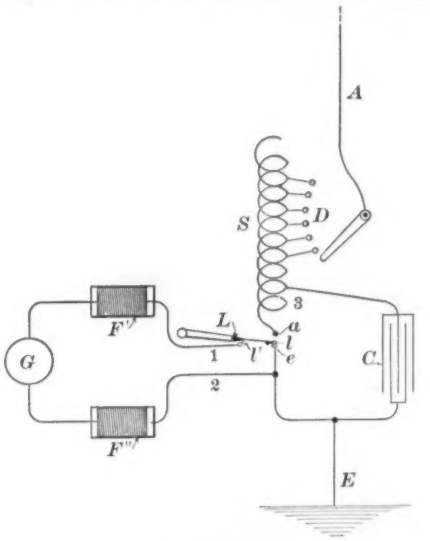


FIG. 4.—KING TRANSMITTER TUNED.

the key. The movable contact may then be returned to its normal position with the terminal, *e*, by the spring, *l'*.

Normally, that is, when the key is open, the current from the generator passes through the self-induction coils, F^1, F^2, the charging lever, *L*, contacts *l*, *e* and part of the earthed side of the closed oscillation circuit; it is evident there can be no potential difference impressed between the terminals, *a* and *e*, of the oscillation circuit and consequently there will be no resulting radiation from *A*.

Having the dynamo circuit possess a great electromagnetic momentum by including the auxiliary self-induction coils, F^1, F^2, a

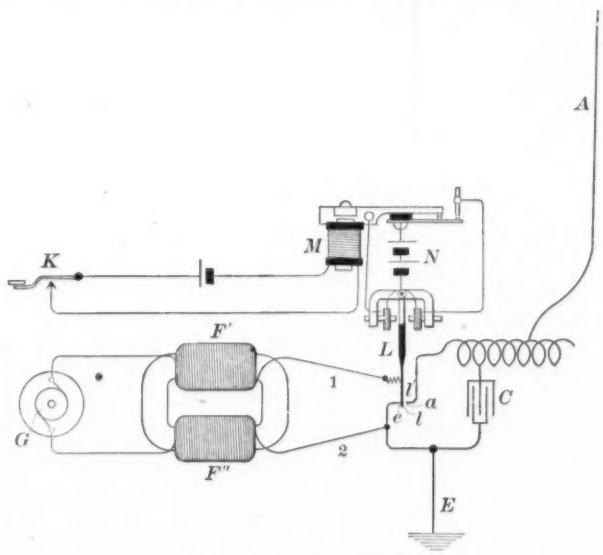


FIG. 5.—KING TRANSMITTER.

great exhalation of potential difference will manifest itself between the receding contact, *l*, and the stationary contact, *e*, if the former contact is rapidly traversing the air-gap intervening between *a* and *e*. The potential difference available at the instant of contact for setting up electric oscillations in the closed circuit when the magnet, *M*, is energized, will be an increase in voltage greatly in excess of that supplied by the generator previous to the instant of rupture between the fixed and movable contacts. It is here that the small superficial area of the contact, *a*, plays its part, for it facilitates the discharge between the contacts when the lever is returning to its normal position when released by the magnet controlled by the transmitting key.

With circuits arranged similar to those in Fig. 3 the energy available for effective radiation will take the form of reflexes given off on one side of the closed circuit oscillator. The time rate of change of these reflexions given to the open circuit radiator may become to a certain extent definite and identical with the free period of the closed circuit to which it is looped if this period is of any appreciable strength and purity. To eliminate any dissimilarity between the periods of the open and closed circuits recourse is had to the inductance coil as shown in Fig. 4.

By including a small amount of bunched inductance in the open radiator circuit it is possible to give it a slight selectivity and in having the possible periods of this circuit more strongly accentuated it is possible to exalt these particular surges traversing it by utilizing the mutual induction effect of a resonant closed circuit on it.

The bunched inductance in series with the vertical aerial is represented by the coil, *S*, Fig. 4. This tuning coil is divided into six sections, each of which may be successively connected by means of the selector switch, *D*, in series with the aerial wire, giving to the latter distinct selectivities by which any one of six of its possible periods may be exalted to predominance by the mutual inductive association of the closed circuit resonator.

As in the transmitting apparatus described above, so in the receiving devices employed by King there is much that is new and of interest. Without rehearsing the long list of objectionable features which are notorious in the present methods of electric wave translation it may be stated again that receptors using Morse registers are cumbersome in construction and sluggish in action; the siphon recorder is too complicated and delicate in the hands of the average electrician and the telephone receiver leaves no record of its messages.

The King receptor, or differentiator, as he terms it, is a device that is at once light and compact, simple and easily managed, gives a permanent record and is sufficiently rapid to receive a machine-sent message. Added to these exceptional features is its sensitiveness to the slightest variations occasioned in the resonating system in virtue of the impressed electric waves which impinge upon it.

To properly indicate these transformed impulses, especially when they recur at exceedingly short intervals, as in wireless telegraphy, its value is at once apparent, for these features tend toward reliable

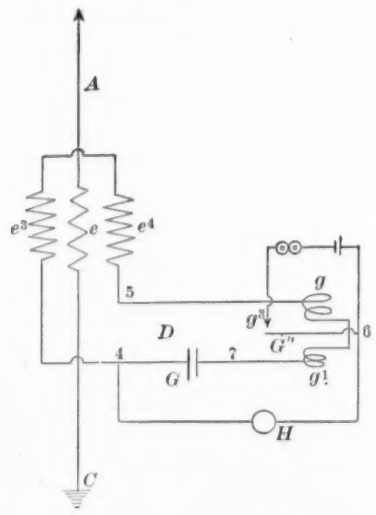


FIG. 6.—KING RECEPTOR.

service with greatly increased confidence on the part of the operator as well as it will finally upon the somewhat skeptical public.

To secure extreme sensitiveness, the King differentiator depends for its operation in a differentiation between the effective pole strength of one of two relatively opposed magnetic fields to produce a minute angular deflection of a small magnetic needle to which is fastened a very light reflecting mirror, the system being suspended by a thin strip of phosphor-bronze or similar non-magnetic metal. In this the scheme is very like the design of an oscillograph.

To secure stability, that is, freedom from drift, the controlling elements should have a permanent appreciable influence over the swinging systems, consequently this is placed between the poles of a permanent magnet; the strength of these poles are reinforced by currents traversing the winding, which is generated by a local exciter.

For differential action between either pole of the permanent control magnet on the swinging system, the normal values of the currents traversing these windings are such that the active poles act equally and oppositely on the magnetic needle and any disturbance, such as that caused by an electric wave striking the aerial receiving wire, of this relation between the normal values of currents traversing either winding will consequently produce a momentary deflection of the magnetic needle and its attendant mirror.

To better understand the changes in the current values and of the

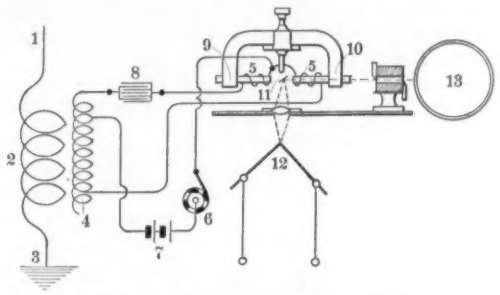


FIG. 7.—KING DIFFERENTIATING RECEPTOR.

magnetic states they represent, as they occur in the various circuits, reference may be had to the accompanying diagrams. In the case shown in Fig. 6, the aerial resonator circuit is represented by *A* in series with the exciting coil, *e*, terminating in a ground connection, *C;* inductively associated with this primary inductor is a secondary coil or coils, e^3, e^4, constituting a step-up transformer; the latter coils form, with the solenoid, *g'*, one of two parallel connected branch circuits of the local exciter, *H*.

The purpose of the exciter, *H*, is to impress on the ends, 4 and 6, a periodically varying current of comparatively low e.m.f. This exciting current should have a maximum e.m.f. of an inferior value to that of a resulting secondary p.d. between 4 and 5, induced in e^3, e^4, by a positive energy transfer through the exciting coil, *e*, due to a received wave. A normal difference in current phases of at least 90° is obtained between 5 and a similar point, 7, on the second branch circuit, including the condenser, *G*, and the solenoid, *J'*, by a suitable adjustment of the capacity value of *G* with respect to the inductances, e^3, e^4.

The inductance value of both solenoids, *g* and *g'*, should be negligibly small as compared with the reactions of both the secondary, e^3, e^4, and the capacity, *G*, so as not to introduce seriously disturbing elements into the circuit. Assuming that the normal phase angle between currents traversing each solenoid is 90° it is interesting to note that the resultant magnetic field of the solenoid, *g*, will be zero while the field of *g'* will simultaneously assume a maximum value.

With solenoid windings in the direction shown, the consequent magnetic field of *g'* in the capacity branch will normally impress a predominating influence on the swinging armature, G^4. As a sequence, the action on a polarizable mass, as for instance the armature, G^4, under consideration, will be solely due to *g'* providing the normal phase angle does not exceed 90°; if the phase angle is in excess of 90° there will be an increased pull away from the constant, g^3, this being the result of a mutual co-operation of the two respective fields of both *g* and *g'*.

Under normal conditions the secondary coil or coils, e^3, e^4, act simply as an impedance, retarding the current phase, and thereby minimizing the effective pole strengths of one of the two solenoids. When, however, the inductor, *e*, is energized by an electric wave impinging upon the aerial the effect of the induced current in the opposed solenoids on the closed circuit, *O*, is such that it will cause an orientation from the normal, in the positions of the antinodal points of the effective current wave of the exciter, *H*.

The crests of the effective energy wave being forced from the normal, 4_1, 6_1, will assume new positions, 4_1, 7_1, if the superposed e.m.f. of the secondary coils of the transformer is even slightly superior to the normal current wave developed by the exciter, *H*. It now becomes evident that under the influence of the superior wave developed by the transformer coils the energy transfer in the closed circuit will pass successively through *g* and *g'*, instead of transversing them, as parallel connected circuits excited by *H;* then the resultant magnetic action of the solenoids on the mass represented by the armature will equal the sum of the effective strengths of the mutually co-operating fields, *g*, *g'*.

Fig. 7 illustrates the final form of King differentiating receptor in which 1 represents the vertical open oscillator collecting circuit

in series with the inductor, 2, of the oscillation transformer, which leads to earth at 3, the secondary of the transformer, 4, forms with the solenoid, 5, one of the two parallel connected branch circuits which includes the interruptor, 6, and a couple of cells, 7; the latter supplies the circuit with a current of low e.m.f.; the interposed condenser is shown at 8, while 9 and 10 are the opposed solenoids, 11 is the swinging mirror, which reflects a concentrated branch of light from the lamp, 12, projecting it on a moving band of sensitized paper, 13.

This is the new American system as evolved by King, and one which should be able to compete successfully with the best that the various wireless interests have to offer to a critical but not a very exacting public.

The Electrical Testing Laboratories.—III.

(*Concluded.*)

By Clayton H. Sharp.

THE photometric measurements connected with the process of conducting life-tests are made in the industrial photometer room. For the testing of lamps of the 50-volt range and of the 200-volt range, another smaller compensator is provided, or a 2 to 1 transformer can be used. For series lamps a constant-current transformer is employed.

Since such elaborate precautions are taken to insure the constancy of the voltage on the life-test lamp, it is evidently equally important to measure and to check this voltage with a high degree of accuracy. The fundamental voltage fed to the transformer is maintained at the right point, as shown by the indications of a sensitive Weston alternating-current voltmeter on the generator switchboard. The accuracy of this voltmeter is checked in a number of different ways, all of them going back to a direct-current voltmeter, checked by means of a potentiometer and standard cell. The use of the electrostatic voltmeter in this work has been mentioned in connection with the alternating-current voltage-measuring apparatus. This method gives exceedingly accurate results. A further method consists in the careful photometry of an incandescent lamp on direct current of a given voltage and then on the life-test current of the same nominal voltage. The candle-power obtained in the two cases must agree. To facilitate such checks a heavy pair of wires is run from the life-test racks to one of the industrial photometers. Pressure lines are run from all of the life-test racks to the alternating-current voltage checking table, where these various pressures may be readily measured by referring to a laboratory standard alternating-current voltmeter or to the electrostatic voltmeter. It is only by taking continual and elaborate precautions of this kind that the accuracy of the results of a life-test can be assured. In connection with the life-test it should be mentioned that a storage capacity in trays is provided for 50,000 lamps, while over 3,000 lamps can be preserved under lock and key for future reference and checks.

VACUUM TESTING.

The degree of exhaustion attained in lamps submitted for test is estimated by observing the glow produced when one terminal of the lamp is connected with the terminal of a small induction coil while the lamp-bulb is held in the hand. A blue Geissler glow indicates a low vacuum. With well-exhausted lamps only faint and fitful discharges through the vacuum are seen.

This test is installed in a small room by itself, which also contains an arrangement for detecting thin parts in lamp filaments. Such parts become evident by their greater brightness when the whole filament is heated up to a rather dull red heat.

STANDARD PHOTOMETER ROOM.

This photometer is installed in a room 12 by 30 feet, and consists of a Reichsanstalt type of photometer bar three metres long, together with a carriage to which can be fitted a Bunsen photometer, a Lummer-Brodhun contrast photometer made by Kruess, or a Lummer-Brodhun contrast photometer made by Schmidt & Haensch. In ordinary operation the lamps are placed on stands or rotators supported on adjustable tables at the ends of the photometer track. The distance between lights is then 5 metres. This distance can be varied at will by changing the position of the tables. The photometer disk is carefully screened from stray light by black sheet-iron screens. In connection with this photometer especial attention has been given to the electrical measurements. A potentiometer, with its standard cell and standard resistance for current measurement, is permanently installed on a table at one side of the room. On the same table are a pair of Weston laboratory standard instruments. In all work requiring high precision, such as checking the determinations of the value of standard candle-power lamps, the electrical measurements are made with a potentiometer directly, thus securing a higher degree of accuracy than is obtainable in the photometrical measurements. For the most precise work the Schmidt & Haensch photometer is used, this photometer being highly sensitive and accurate. The standard photometer finds an important field of usefulness in checking the results obtained on the industrial photometers and in the final determination of the value of standard candle-power lamps prepared by the Laboratories.

INTEGRATING PHOTOMETER.

While the mean spherical candle-power of incandescent lamps can be determined on the standard photometer, using either a universal rotator or a mirror form of lamp holder, yet it has been found advisable, in view of the considerable number of such measurements which have to be made, to install a Matthews integrating photometer for carrying out the same. The description of this photometer, which has been presented to the American Institute of Electrical Engineers, need not be repeated at this place. Suffice it to say, that when the

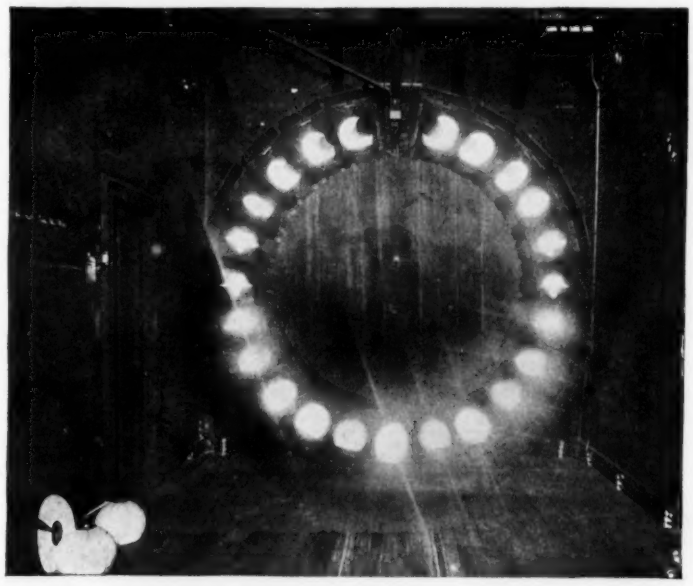


FIG. 15.—ARC LIGHT PHOTOMETER MIRRORS.

working standard on this photometer has been adjusted, using lamps standardized in terms of their mean spherical candle-power a series of measurements of the mean spherical candle-power of test lamps can be made with approximately the same rapidity and accuracy as the ordinary measurements of mean horizontal candle-power on the industrial photometers.

As has been noted above, this method of adjusting the working standard eliminates the influences of mirror absorption.

EXPERIMENTAL PHOTOMETER ROOM.

This room, which is designed for carrying out photometric testing of a peculiar or special nature, is of practically the same size as the standard photometer room. It also contains a Reichsanstalt type of photometer bar. A special piece of apparatus in this room is a mirror device for determining the vertical distribution of luminous intensity about sources of light which must be used in a vertical position. This consists in a stout framework of iron which can be rotated about a horizontal axis, the prolongation of which passes through the lamp. Three mirrors of plate glass, each 22 by 31 inches, are distributed so that light proceeding from the lamp is, after three reflections, directed along the prolongation of the axis of the rotation of the frame, which is also the axis of the photometer bar. By rotating the entire frame about its horizontal axis the light is received from the lamp at various vertical angles of emission and thrown on the photometer disc. Consequently, the lamp being in a fixed position, its intensity in any direction can readily be measured by the photometer.

This arrangement is adapted to the photometry of gas lamps as well as electric lamps. It is particularly useful in the study of the distribution of light about Nernst lamps and about large clusters of incandescent lamps with shades or reflectors. In the latter form of test the cluster and shade are attached to the shaft of a ceiling fan motor, whereby both are rotated at a suitable speed and the average value of intensities in various vertical zones is at once obtained. In tests made with this apparatus the photometer box is set up in a fixed position at the end of the photometer bar. Adjustments to equal illumination are made by moving the working standard lamp along the bar by a simple system of cords and pulleys.

REFLECTOR PHOTOMETER.

This photometer is installed in the industrial photometer room. It is intended primarily for the measurement of the distribution of the intensity of light about large incandescent lamps and lamps or clusters of lamps with globes or reflectors. The rotator to which the lamps are attached is built with its rotating axis horizontal. This axis can be turned about a vertical axis, thus presenting all angles of the lamp successively to the photometer. The rotator is built of such size and strength that globes or reflectors can be attached to it directly,and measurements are made without the interposition of mirrors. For this again the distance to the photometer box is fixed and the working standard lamp is moved. The reading of the working standard is obtained from a steel tape attached to the lamp carriage and passing over an idler in front of the photometer reader. This tape is graduated directly in candle-power.

ARC PHOTOMETER ROOM.

This is a room, 13 by 72 feet. In it is installed an arrangement for the photometry of arc lamps after the plans of Professor Matthews, who personally superintended the installation. In this arrangement the arc lamp is placed in the center of a vertical truncated pyramid of 24 large mirrors. (See Fig. 15.) The light from these mirrors is sent to a focusing point, at which the photometer disk is placed. In the path of each beam is placed a sector of smoked glass, which by its absorption diminishes the intensity of each beam in the ratio of the cosine of the angle which the mirror sending that particular beam makes with the horizontal to unity. Under these circumstances, the illumination received by the photometer disk is proportional to the total flux of light emitted by the lamp, and consequently to the mean spherical candle-power of the lamp. Hence mean spherical candle-power or mean hemispherical candle-power can be obtained directly. The same arrangement of mirrors suffices also for the determination of the vertical distribution of luminous intensity about the lamp, and of the influence of various shades, reflectors and inner globes.

The table carrying the photometer disk and track and the stand carrying the smoked sectors are mounted on wheels which run on a track lengthwise along the room. The mirrors can be tilted so as to throw their light toward the photometer disk when the latter is placed at any distance from them. This arrangement is a very advantageous one, inasmuch as when very powerful arcs have to be measured, the intensity of the illumination on the photometer disc can be diminished simply by increasing the length of path which the light traverses, while for very feeble arcs the path may be made quite short. Readings of the distance of the working standard lamp from the photometer disc are taken either from a graduated steel tape after the manner described above or from a permanent record made on a sheet of paper wrapped around a drum and punched by means of an electromagnetic arrangement attached to the lamp carriage and operated by the photometrist. This latter recording device is due also to Professor Matthews. It enables a very large number of photometer settings to be made quickly, following the variations in intensity of the arc, and so a mean value for the intensity of the latter to be obtained.

It is to be noted that the arrangement of mirrors produces an illumination on the photometer disc which is proportional to the sum of the intensities of the light emitted by the arc in two vertical planes 180 degs. apart. This illumination is at all times much more nearly proportional to the average intensity of the arc than when the light from one side only of the arc is taken.

To facilitate the manipulation of the lamps and particularly to enable life-tests of electric light carbons to be made conveniently, a loop of track on which small cars run has been supported from the ceiling in the main room, just outside the photometer room. A spur of this track runs into the photometer room. Arc lamps under test are supported from the cars and are allowed to burn uninterruptedly. All adjustments and electrical measurements are made in the outer room. When a lamp is to be measured, it is wheeled through a door to its position at the centre of the pyramid of mirrors without interrupting its burning or disturbing its régime in any way. After the photometric measurements have been made, it is wheeled out again and switched to the other side of the loop so that the next lamp in the line can succeed it in the photometer. The loop is of sufficient size so that a life-test of 10 or 12 pairs of carbons can be carried on simultaneously.

GAS LIGHT TESTING.

The necessary apparatus for gas-light testing, including a standard testmeter, pressure governors, pressure gauges and micrometer cocks, have been installed in the experimental photometer room. Measurements of the candle-power and distribution of luminous intensity of gas flames and incandescent mantle burners can be made on the photometer in this room. Pipes have been run from the measuring apparatus to the far end of the arc photometer room, where is erected a standard on which street lighting burners can be placed. The measurements of the illumination which such burners produce at different distances up to 65 ft. from the base of the lamp can be measured by means of a suitable luminometer. By the above arrangements life-tests of mantles can be made, and studies of the influence of shades and reflectors on the distribution of light from gas burners.

A 10-candle-power Pentane standard lamp is at hand for use in ordinary gas-light testing.

It is planned also to make tests of acetylene burners in a similar way.

SPECTROPHOTOMETER.

Appreciating the ever-increasing importance which the color factor is assuming in connection with artificial lights, a spectrophotometer of the best type has been installed. This consists of a spectrometer fitted with two collimator tubes instead of one. At the point of convergence of the collimator tubes is placed a Brace prism—an ingenious device due to Professor Brace, of the University of Nebraska—which receives the light from the two collimator tubes, disperses it equally and refracts it into the observing telescope. On removing the eye-piece of the telescope and focusing the eye on the prism, the observer sees the spectrum of the source of light which is placed in front of one of the collimators as a narrow band across the field, while the spectrum of the source of light in front of the other collimator fills the upper and lower portions of the field and meets the first spectrum along perfectly sharp lines of separation. With proper adjustment the same colors in the two spectra are exactly above each other. The collimators are fitted with symmetrical micrometer slits, so that the intensity of the one spectrum or of the other can be varied by opening or closing the jaws of the slits until an equality of intensity for any given wave-length is obtained. Thus the ratio of the intensities of the two lights in every color of the spectrum can be determined and a quantitative analysis of the color value of one source of light in terms of the other standard source is obtained. For instance, in studying the light of the arc as compared with the incandescent lamp, it would be found that the arc is a certain number of times brighter in the violet than is the incandescent lamp, a smaller number of times brighter in the blue, green, etc. Such analyses are of great importance, in view of the variety of tints which are represented by the more modern sources of light.

PRIVATE LABORATORIES.

An innovation which it is believed will be of considerable convenience to the electrical public is the setting aside of three rooms as private laboratories, to be leased to responsible and competent persons for conducting private tests and researches. These rooms are equipped with tables, with gas and with wires leading to the distribution switchboard. Having leased one of these rooms an electrical engineer has all the facilities of the Laboratories at his disposal. Electric currents of various descriptions and abundant apparatus are at hand for carrying out any such researches as he prefers to conduct personally. Of the nature of the work which he is doing no one but himself need have any knowledge. Researches of this sort are not necessarily confined to these rooms, but may by special arrangement be made in any available part of the building.

In the above description mention has been made only of those classes of work which have been specifically provided for and laid

out. A great many kinds of tests other than the ones which have been touched upon above lie within the scope and the resources of the Laboratories. Abundant space is there for fitting up and testing large and small electrical machinery. Electrochemical tests can be arranged for with very little difficulty. Many varieties of experimental work which are of a physical, mechanical or optical rather than electrical nature, can be carried out with the facilities on hand.

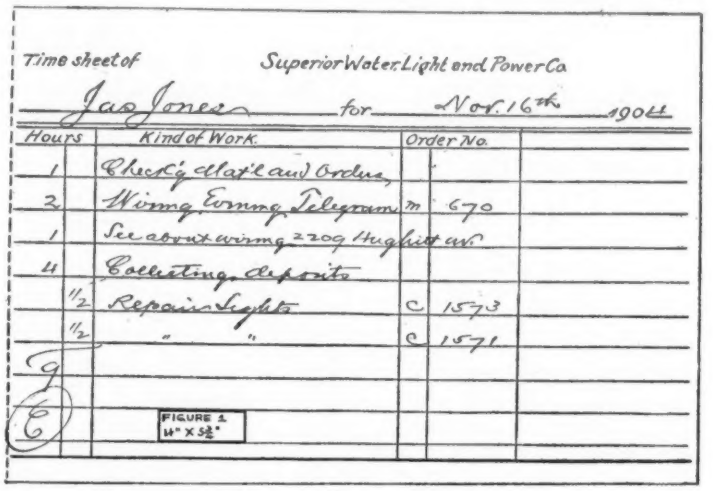
With the best buildings and equipment, reliable testing work cannot be carried out unless a tried and competent personnel is present to conduct the same. Realizing this fact, the management has endeavored to bring together a staff of trained and educated people, by whom all testing work accepted by the Laboratories can be carried to a satisfactory conclusion.

Central Station Payrolls and Labor Distribution.

By W. H. Winslow.

ONE of the most difficult accounting problems for the central station of small or medium size is the payroll distribution—this because of the fact that many of the employees necessarily have their time divided between various subdivisions of the operating and construction accounts. The forms here described have been in use for over a year by a company operating a combined water, gas and electric plant, and their use has resulted in a considerable saving in time, as compared with methods formerly used, as well as greater accuracy of distribution.

The daily time slips (Fig. 1) are put up in books of 50, and each employe, except such as are continuously employed in one kind of work, such as dynamo tending and lamp trimming, is required to turn one in every day to his superintendent. They are then entered by the superintendent on the distribution sheet (Fig. 2), of which one is provided for each employe, except that in the case of laborers


Time sheet of Superior Water Light and Power Co.

Jas Jones for Nov. 16th 1904

Hours		Kind of Work		Order No.	
1		Check'g Mail and Orders			
2		Wiring, Evening Telegram	m	670	
1		See about wiring 2209 Hughitt ave			
4		Collecting, deposits			
	1/2	Repair lights	c	1573	
	1/2	" "	c	1571	
9					
1					
6					

FIGURE 1. 4" X 5½"

FIG. 1.—DAILY TIME SLIP.

book and payroll (Fig. 3), who enters the total time shown on each slip.

At the end of the first half of the month the total columns only of the distribution sheets are footed and compared with the payroll extensions as a check on the correctness of both; this is again done at the end of the month, when the distribution columns are also footed, proved with the totals, and the dollars and cents computed and placed under the hours. These figures are now transferred to a general distribution sheet (Fig. 4) which, when footed, must balance with the totals of the two payrolls for the month.

In the case of the company where these forms are used the payrolls are divided as follows:

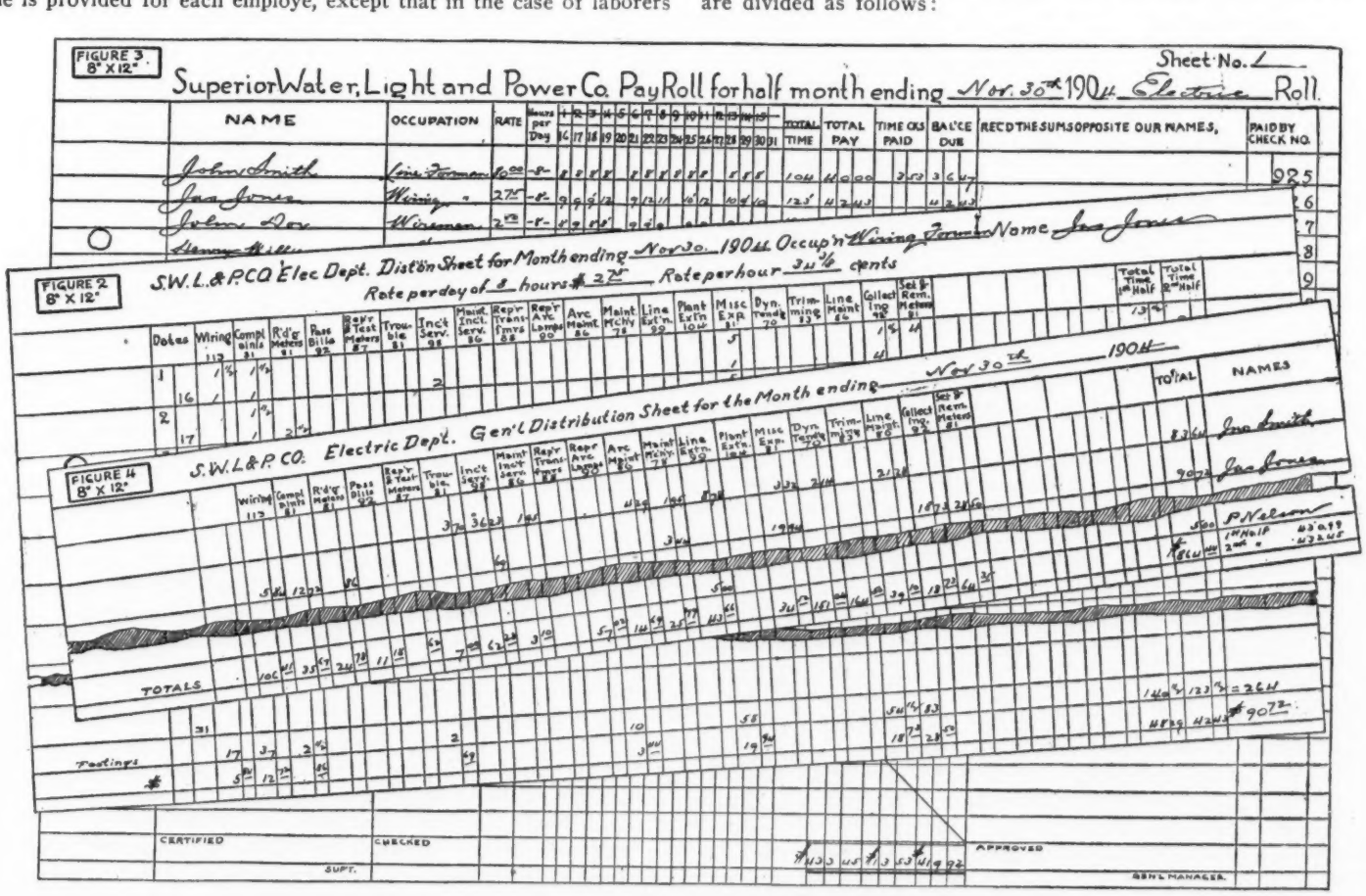


FIGURE 3. 8" X 12"
Superior Water, Light and Power Co. Pay Roll for half month ending Nov. 30th 1904 Electric Roll.
Sheet No. 1
NAME
OCCUPATION
RATE
TOTAL TIME
TOTAL PAY
TIME CKS PAID
BAL'CE DUE
REC'D THE SUMS OPPOSITE OUR NAMES,
PAID BY CHECK NO.
John Smith
Jas Jones
John Doe
FIGURE 2. 8" X 12"
S.W.L.&P.CO. Elec Dept. Distⁿ Sheet for Month ending Nov 30. 1904 Occup'n Wiring Foreman Name Jas Jones
Rate per day of 8 hours $2.75 Rate per hour 34 4/6 cents
FIGURE 4. 8" X 12"
S.W.L.&P. CO. Electric Dept. Gen'l Distribution Sheet for the Month ending Nov 30th 1904
TOTALS
Footings
CERTIFIED
SUPT.
CHECKED
APPROVED
GEN'L MANAGER

FIGS. 2, 3 AND 4.—FORMS OF PAYROLL AND DISTRIBUTION SHEETS.

one sheet headed "Men at $—— per day" is sometimes used for an entire gang. It is, of course, not necessary to have this work done by the superintendent, but it has been found highly beneficial, since it keeps him in close touch with the work of the employes, and it consumes very little time and insures an accurate distribution. After the slips have been thus entered they are initialed by the superintendent and turned over to the clerk in charge of the combined time

1. *Electric,* which covers dynamo tenders, lamp trimmers, linemen, inside wiremen and all other employes of the electric department, except engineers, firemen and coal passers. This payroll, as stated, is distributed by the superintendent of the electric department.

2. *Stations,* which covers all the men employed at the pumping station, filter plant and gas works and all those at the electric station, except the dynamo tenders. This payroll is distributed by the chief

engineer, and but one distribution sheet is used, as there is little or no variation in the work of the men it covers.

3. *Gas,* which covers fitters, complaint men, etc., under the superintendent of gas distribution by whom the payroll is distributed.

4. *Water, Street and Miscellaneous,* which covers employes of the water meter department, men engaged in laying water and gas mains and house connections, teamsters, barnmen, etc., and is distributed by the outside foreman in charge of street work.

The above division is given merely as a suggestion, the underlying idea being so to divide the payrolls that the distribution of each may be made by the official in direct control of the men it covers. The various general distribution sheets having been proved with the respective payrolls, the totals are transferred to the back of the payroll voucher for entry in the voucher journal.

All this sounds perhaps laborious and complicated, but in practice it is not. The payroll and distribution sheets are of the same size, and are punched for filing in a binder where each payroll appears, followed by its distribution sheets, making a compact and complete showing of the labor disbursements of the company.

As only the distribution sheet of the "electric" payroll is illustrated, I give below headings of the sheets covering the other rolls:

STATIONS.	GAS.	WATER, STREET & MISC.
Wages, water plant.	Deliver gas bills.	Maint. of wks. water plt.
Misc. exp. water plant.	Collect gas bills.	Maint. of filter water.
Filter exp. water plant.	Gas stove dept.	Maint. of mains water.
Reprs. machy. water plt.	Rep. gas leaks.	Maint. of hydts water.
Reprs. intake and wells.	Gas piping.	Maint of serv. water.
Flush mains.	Gas meter dept.	Turn on and off water.
Uuload. coal water plant.	Gas lamps and supplies.	Extension of mains.
Wages, gas plant.	Gas arc lamps.	Extension of works.
Reprs. machy. gas plant.	Mis. exp. gas distribn.	Water connections.
Unload coal gas plant.	Janitor.	Maint. of works gas plt.
Wages (steam) elec. plt.		Maint. of mains gas.
Wages (dyn.) elec. plant.		Maint. of serv. gas.
Reprs. (steam) elec. plt.		Exten. of mains, gas.
Reprs. (dyn.) elec. plant.		Exten. of works, gas.
Unload coal elec. plant.		Gas connections.
		Pumping drips.

Following is some further information concerning the forms:

The daily time slip (Fig. 1) is printed on cheap and light, but strong, manila paper. The initials shown in "Order No." column stand for "Misc. Order" and "Complaint."

The individual distribution sheet for month (Fig. 2) is printed on 16-pound folio blue bond paper. It will be seen that each horizontal space is used for two dates, this having been found more satisfactory than a narrow space for each day.

The timebook and payroll (Fig. 3) is printed on 16-pound folio buff bond paper. This form is used for the first or last half month by ruling out one or the other set of date headings. It is arranged for signatures when payment is made in cash or by bearer checks, but for regular employes I much prefer paying by "Order" checks and merely stamping the check number, as shown.

The general distribution sheet for month (Fig. 4) is printed on 16-pound folio white bond paper. This is shown as a separate form, but if desired it is very easy to use one of the individual sheets for the purpose. The figures shown in the headings of Figs. 2 and 4 are the subdivisions of the "voucher journal," to which the sums covered are charged. The list of subdivisions for a combined electric,

WATER DEPARTMENT			GAS DEPARTMENT			ELECTRIC DEPARTMENT		
	PRODUCTION (OPERATION)			PRODUCTION (OPERATION)			PRODUCTION (OPERATION)	
1	Fuel for Station		36	Gas Coal		68	Fuel for Station	
2	Sup't'c'e and Wages at Station		37	Enricher		69	Superintendance and Wages—Eng. Dept.	
3	Lubricants and Waste		38	Steam Coal		70	" " " Dyn. Dept.	
4	Light		39	Purifying Materials		71	Lubricants and Waste	
5	Misc. Mfg. Sup. and Expenses		40	Sup't'd'c'e and Wages at Station		72	Misc. Mfg. Sup and Exp—Eng. Dept.	
6	Filter Exp., Sand, Cleaning, etc		41	Misc. Mfg. Sup. and Expense		73	" " " " —Dyn. Dept.	
7			42			74		
	PRODUCTION (MAINTENANCE)			PRODUCTION (MAINTENANCE)			PRODUCTION (MAINTENANCE)	
8	Repairs of Buildings		43	Repairs Buildings and Holders		76	Repairs of Buildings	
9	Repairs of Machinery		44	Repairs Apparatus and Mach.		77	Repairs of Steam Plant	
10	Repairs of Filters		45			78	Repairs of Electric Plant	
11	Repairs of Intake and Wells					79	Repairs of Shop Tools and Mach.	
12						80		
	DISTRIBUTION (OPERATION)			DISTRIBUTION (OPERATION)			DISTRIBUTION (OPERATION)	
13	Sup't'd'c'e and Wages		46	Sup't'd'c'e and Wages of Dist'b'n		81	Sup't'd'c'e and Wages of Dist'b'n	
14	Flushing and Cleaning Mains & Services		47	Protecting and Thawing Services		82	Arc Lamp Carbons and Globes	
15	Protecting and Thawing Hydts		48	Setting and Removing Meters		83	Arc Lamp Trimmers	
16	Gen'l Distribution Supplies and Expenses		49	Misc. Dist'b'n Expenses		84	Incand't Lamp Renewals	
			50			85	Misc. Distbn. Sup. and Expenses	
	DISTRIBUTION (MAINTENANCE)			DISTRIBUTION (MAINTENANCE)			DISTRIBUTION (MAINTENANCE)	
17	Repairs of Mains		51	Repairs of Mains		86	Repairs Pole Lines and Circts	
18	Repairs of Services and Hydts		52	Repairs of Services		87	Repairs of Meters	
19	Repairs of Meters		53	Repairs of Meters		88	Repairs of Transformers	
20						89	Misc. Incand't Repairs	
						90	Arc Lamp Repairs	
	GENERAL OPERATION			GENERAL OPERATION			GENERAL OPERATION	
21	Salaries Officers and Clerks		54	Salaries Officers and Clerks		91	Salaries Officers and Clerks	
22	Office Expenses and Rent		55	Office Expenses and Rent		92	Office Expenses and Rent	
23	Advertising and Soliciting		56	Advertising and Soliciting		93	Advertising and Soliciting	
24	Legal Expenses and Claims		57	Legal Expenses and Claims		94	Legal Expenses and Claims	
25	Taxes		58	Taxes		95	Taxes	
26	Bad Debts		59	Bad Debts		96	Bad Debts	
27	Misc. General Expenses		60	Misc. General Expenses		97	Misc. General Expenses	
28			61	Gas Stove Dept.		98	Home Service Dept.	
			62					
	EXTENSION			EXTENSION			EXTENSION	
29	Mains		63	Gas Mains		99	Lines and Poles	
30	Hydrants		64	Gas Meters		100	Transformers	
31	Meters		65	Gas Works		101	Meters	
32	Station		66	Gas Services		102	Real Estate and Buildings	
33	Intake and Wells		67			103	Steam Plant	
34	Filters					104	Electric Plant	
35						105		

FIG. 5.—FORM OF VOUCHER DISTRIBUTION SHEET FOR THREE DEPARTMENTS.

gas and water plant (Fig. 5), while pretty well condensed, is perhaps sufficient for a company of moderate size. Where, however, an electric business only is conducted, considerable further subdivision could be made with advantage.

Telephone Line Engineering.

At the January meeting of the Franklin Institute, Mr. C. J. H. Woodbury read a paper on Telephone Engineering in which he gave much interesting data.

The extent of the pole lines, he said, is shown by the fact that in the Bell telephone system there are approximately 6,300,000 poles, and about 1,000,000 are required annually for replacement and for extension of lines. A number of years ago a large collection of logs, known as the Joggins raft, was towed from Nova Scotia to New York, and this raft contained many long poles which were not suitable for masts. Some of these long poles were used for the largest pole line ever built, at the westerly side of New York City, and carrying 250 wires each. At the present time there are single underground cables comprised of 4 8/10 times as many conductors, and under the main streets in the principal cities are conduits of sufficient capacity to carry four hundred times as many wires as one of these pole lines.

Where the soil is not firm enough to sustain a pole imbedded in the usual manner, security may be obtained by extending the supporting area by plank at the bottom of the excavation and filling the hole with concrete, or braces may rest upon a platform placed on the surface of the ground, and in some instances these platforms rest

upon piles. In other instances these braces rest upon plank placed underground, or, in place of a single pole, they are placed in pairs, either vertical or joined at the top and connected by strong wire at the ground, making what is known as an A pole. When the line changes its direction or there are other causes to make a lateral pressure against a pole, it is secured by braces or by guys, either running to an anchorage in the earth or to some other object.

When a telephone line is built in or near cities, the close connection with supplies and labor renders that portion of the work comparatively easy, but in the construction of long-distance lines across country, connecting various cities, towns and villages within speaking distance of each other, it is necessary to provide means for the execution of the work on an independent basis. If the route runs through a wooded country, a wide swath is cut in the forest and the post holes may be made by the diggers, or in other instances a charge of dynamite deposited in an auger hole makes quick work, the greatest relative gain being in compact clayey soil.

Meantime the poles have been brought to their sites by teams and then moved to the exact place by the help of an axle mounted on a pair of wheels termed a dinkey; gains are cut and the cross arms attached before they are raised, either by all hands with pikes giving a long push, a strong push and a hard push all together, to change the old aphorism, or if the country is not too rough to permit, a portable derrick mounted on a wagon is drawn to the site, then the horses are taken from the pole and pulling at the rope quickly raise the pole. Then the derrick wagon is drawn to the next pole and the work proceeds rapidly. When the line changes in direction the pole is rendered more secure by guys and the pole line is ready for the wires which are payed out from a number of reels in a wagon, thence passing through a set of guiding holes which prevent snarling. The final attachment of the wires to the insulators on the cross arms is very carefully done, because it is necessary that the wires should be drawn to an extent that they should not sway against each other, and yet not so tightly that the contraction in cold weather would put a stress on the wire which would produce danger of breakage, for at these small amounts of dip in the wires a slight difference in the length of the line will cause a great variation in the stress.

The stresses to which a telephone pole is subject are the result of many and variable combinations of live and dead loads upon a beam fixed at one end and loaded near the other end. There is scarcely anything in engineering construction so actively the subject of depreciating conditions. The top is exposed to the weather and the important section near the surface of the ground is the portion most energetically attacked by decay. The wood is assailed by animal life, whether it be gnawing by horses in town or the perforation by woodpeckers in remote districts. Poles in wild countries are bitten by bears in search of bees, whose humming is imitated by the vibration of wires, and it is said that in India the tigers use the poles to sharpen their claws upon after the manner of their second cousins, the domestic cat, but with so much more vigor that the poles become weakened. Not only are they wrecked by storms, but freight car roofs frequently fly off and strike the poles edgewise with destructive result.

Iron poles are but rarely used in this country, the principal condition governing their selection being on some lines in prairie countries in the West where campers are so prone to cut down wood poles for fuel, that tubular iron poles have been substituted. In Europe there are many iron poles, and in tropical countries infested with white ants it is necessary to use iron poles or to attach the wires to living trees.

Antiseptic methods for treating poles as a preventive against decay and the attacks of insects have not been so general in the United States as in Europe, as the relatively sparse settlement and distances between cities having the elaborate plant necessary for treatment would make the transportation of the poles for treatment and back to the sites where they are to be used a prohibitive expense. However, poles treated by creosoting have been used in this country wherever transportation conditions between the sawmill, the treating plant and the sites where they are to be used will permit. These conditions apply to certain portions of the South, where southern pine is sawed to dimensions and then treated. As the cost of this treatment is based on the volume of the timber, these poles are sawed to such proportions of taper as to give the most economical volume of timber to resist the stresses the pole is subjected to. The breaking point of these poles, as computed, is from eight to ten feet above the ground.

While gravelly soil will hold a pole to the limit of its strength, it is necessary to build lines in many places where such conditions do not occur. The New Orleans and Mobile line, along the north shore of the Gulf of Mexico, traverses marshes composed of soft mud which extends to a great depth, upon which a rank sedge grass grows twelve to fifteen feet in height, whose coarse roots form a compact mass about a foot in thickness. In order to prevent this line from being injured by the fires which rage among these marshes in the early spring, the grass is kept cut to a width of 100 ft. along the route. It has been possible to sustain poles along this route by bolting heavy cross pieces across them at the ground level, having cut an opening among the roots through which the butt of the pole can be inserted, and then the pole is braced as occasion may require, sometimes in four directions, each of these braces being supported on a cross piece at the marsh level. In some instances a pair of, or even three, poles are used, each being attached to the same cross arm.

At the Tybee marshes, near Savannah, Ga., the ground is so soft that it cannot be walked upon, and the men engaged in building the line were obliged to lay a line of boards to proceed along the route. When a pole was to be set, cross pieces were temporarily attached to it near the lower end, and men standing upon these supports "jounced" in unison while the pole was held vertically by pikes. Under this human pile driving, the pole sank rapidly, but the mud is so adhesive that in a short time the pole is securely held. Similar methods are used in building the lines across the New Jersey flats, although the conditions are not so severe as at some places farther south.

When ground is too wet and soft to permit digging, poles are frequently set by hewing their butts to wedges, and while the pole is held in a vertical position it is grasped by cant hooks and twisted back and forth, causing it to sink, like the ordinary motion used in boring a hole in wood with a brad awl. When once set the pole is either held securely by braces or guys, or it may be made firm by driving a wood curb around it, excavating the mud between the curb and the base of the pole and filling the space with concrete. In sandy soils, particularly in New Jersey, poles are set on the principle of the jet pile, wherever there is a supply of water. A half-inch pipe about 6 ft. in length is temporarily attached to the side of the pole, with its lower end at the butt. The other end of the pipe is attached to a garden hose, and when the pole is up-ended the stream of water makes a quicksand into which the pole sinks until the water is shut off, and the pole is sustained by pikes until the water settles, leaving the pole securely held by the sand, which becomes water-packed around it.

In mountainous countries the ledges are an impediment to excavations for poles, and although dynamite is frequently used, yet poles are set upon rock without excavation and a large number of stones are piled around them in such quantities as to grip the poles securely, although guys are generally necessary.

A pole line is not designed merely on the basis of the stresses to which the pole is subjected in drawing the wires to the necessary tension, for in most northern climates the sleet will at times form upon the wires until they become icy cylinders perhaps three inches in diameter, and the problem is not that of the mere added weight, for the force of the wind blowing against this icy sail applies a greater horizontal load, which combines with gravity and produces a resultant force in a diagonal direction, greater than either of the contributing units. An ice-laden line swayed by the wind may be successfully resisted by the poles until the oscillations of the pendulum reach a synchronism with that of the vibration of some pole on the line which responds in like manner to the cumulative impact across the direction of the line, until it breaks this individual pole. Then adjacent poles are relieved of the pull on one side, and the excessive unbalanced stress breaks them. Such is the story of a wrecked aerial line, broken by stresses not included in the ordinary course of events, and which must be provided for by large factors of safety.

It is indeed fortunate that meteorological conditions furnishing in sequence rain at just above a freezing temperature, and meeting a colder stratum, without wind, near to the earth, but followed by a gale, are rare and generally are limited to a small area, for they present conditions which cannot be fully circumvented. Officers of the Weather Bureau reported in connection with a sleet storm of unusual severity, that there had not been similar conditions in that locality for twenty-three years. The breakages of lines resulting from a severe storm in Southern New England a few years ago revealed the fact that the damage was confined to the valleys of the rivers emptying into Long Island Sound, while the storm did not appear to be of sufficient severity to cause any damage to the lines on higher

land. It is claimed that sleet never forms to a destructive extent on the wires in certain portions of the northerly part of the United States, and this may be one of the instances of the rarity of such occurrences.

A pole is not to be compared to a mast upon a vessel, for these extreme conditions of severe exposure to telephone lines occur in winter, when the ground is frozen, and holds the base of the pole rigidly, while a vessel in a gale heels when struck by puffs and the sails "spill the wind," and in this manner the masts sustain exposure to winds which would break them if held rigidly to long continued impact. The most undesirable occurrences in connection with the wreckage of aerial lines are the disturbances resulting from the contacts of different electrical systems with each other, when the various lines are so near as to collide, when one or both break. While the currents used on the telephone system are so minute as to be without power of damage, yet their wires, in crossing the lines of electric lighting or power systems, may in making short-circuits cause serious mishaps to the electric lighting or power plant and in any event materially interfere with the service. The imposition of an electric lighting or power current upon a telephone line would destroy the fine apparatus and perhaps cause other injuries, were it not for the protectors for the purpose of preventing these foreign currents from reaching the subscribers' installations, or the telephone central stations. It is far better to prevent the occurrence of harmful conditions than it is to abate their injurious results, by a temporary sacrifice of the continuity of the service, for the operation of a protector serves to open the telephone circuit and to prevent the use of the instruments for the time being, until the lines are cleared and the protectors renewed. The remedy against the liability of such crosses is the simple one stated by a judge of a United States court, in which the decree was given that the distance between the high and low potential lines should be equal to that of the highest pole, so that in the event of the falling of a pole the wires would come short of reaching the other line. In many instances congestion of electric service and narrow streets prevent any such wide separation, and it becomes necessary to take every precaution for substantial construction.

It is necessary for such different lines to cross the others' routes, and in such instances provision against collision is made by the use of extra heavy construction, thoroughly bracing and guying the poles, and arranging against overhauling of the lines in case of their breakage; also guarding the wires so that those on the upper line could not fall over the ends of the cross arms in case of their separation from the points of support. As high-tension wires are of larger diameter and fewer in number, their poles should be higher at the crossover. The crossover span should be short and at such height that in case of breaking next to an insulation the remaining portion of the span wire could not be long enough to reach to the lower line. The necessary height of poles, or the impracticability of placing them in such positions as to provide for the short crossover spans, may sometimes render it unfeasible to adopt this construction, and a grill of hardwood slats placed at frequent intervals across a pair of steel wires or cables between the two spans interposes a screen which prevents a broken wire on the upper span from reaching the lower span. In some instances, where there are but few wires in each line, they are attached to the same pole, and the contact is prevented by a framework carrying guard wires below the upper line. It is not as a general principle advisable to use a single pole crossover.

House tops at the first furnished an attractive route for aerial wires, and some of the fixtures for carrying these wires were of great size, but the framing of most buildings is ill suited to resist the excessive stresses due to such loads, and the introduction of underground conduits has furnished suitable means for such main conductors, but it is necessary to carry branch wires over the tops of houses in order to reach patrons to whom the wires cannot be led in any other manner. In place of the old timber constructions, suitable iron pipe frameworks are now generally used.

The aerial wires are so visibly in evidence, and often to an obstructive extent, that they may be cited as the portion of the system which naturally receives especial attention from the public. The tension on a line suspended between a pair of horizontal supports varies with the sag and is at a minimum when the sag amounts to 7/20 of the span, and the tension increases whether the sag is greater or less than this proportion. For example, with No. 12 hard-drawn copper wire, weighing 173 pounds to the mile, and being .104 in. in diameter, and having a span of 130 ft., the minimum tension of 3 pounds would occur if the sag was 43 ft. 6 in., while it would slowly augment with increase in the sag, and if nature had furnished a chasm deep enough for the experiment, it would be expected to reach its breaking tension of 550 pounds at a depth of 16,470 ft., or 3.17 miles. On the other hand, the increase in tension proceeds rapidly as the wire is drawn to approach a straight line, the breaking tension occurring at a sag of 1½ in.

As a comparison with this instance of the stresses in a local line, in the case of the No. 8 hard-drawn copper wire, .165 in. in diameter and weighing 435 pounds to the mile, as used on long-distance telephone lines, when the span is 150 ft. the minimum tension occurs at a dip of 52 ft. 6 in., when it is only 8¾ pounds, and in like manner, as in the foregoing instance, its breaking stress of 1,328 pounds would be reached at the slightly less dip of 16,100 ft., or 3.04 miles, still too great to admit of confirmation by direct experiment; but if the wire was pulled until the sag was 2 2/10 in., it would require the breaking load of 1,328 pounds.

It is desirable that the wires should be drawn tight enough to prevent them from swaying against each other; but it is important that they should not be drawn so tight that the contraction during extreme cold weather should cause the wire to break. The temperature is carefully noted when lines are being drawn, and the sag is left in accordance with a table based on a factor of safety of five computed for the usual lengths of span throughout a range of natural temperatures.

Length of Span of Hard Drawn Copper Wire in Feet.

	Sag in Inches.					
Natural temp. Fahr.	75	100	115	130	150	200
−30	1	2	2½	3½	4½	8
−20	1½	2½	3	4	5	9
+10	1½	3	3½	4½	6	10½
+30	2	3	4	5½	7	12
+60	2½	4½	5½	7	9	15½
+80	3	5½	7	8½	11½	19
+100	4½	7	9	11	14	22½

When a wire is laden with sleet, the strain lengthens the wire and the increased sag diminishes the tension sometimes to an extent sufficient to save the wires, which would otherwise be broken were it not for this elongation.

The electrical advantages of copper over iron could not be utilized for aerial wires, because commercial copper has so little resilience that it will continually stretch under its own weight and become attenuated to an extent that it will break, until Thomas B. Doolittle produced the hard-drawn copper wire which is now in universal use on aerial lines. The treatment consists in omitting the annealing processes during the latter portion of drawing the wire, but it deviates from the usual method by attenuating the wire by smaller gradations at the latter die plates. The rate of diminishing the wire is wholly an empirical one, at first determined by long and thorough experimentation, and as the hardening occurs for the most part near to the surface, the tensile strength per square inch of section is greater with smaller than with larger wires. For example, No. 8 wire is .165 in. diameter and has a tensile strength of 62,100 pounds to the square inch, while No. 12 wire, .104 in. in diameter, has a tensile strength of 64,600 pounds to the square inch. In comparison with commercial copper wire, which has a tensile strength of about 32,000 pounds per square inch, the strength is nearly doubled. The modulus of elasticity is increased from 12,000,000 pounds to 19,000,000 pounds, or about 60 per cent., while the elongation before rupture is reduced from 35 per cent. to 1¼ per cent. It will be noted that this remarkable change in the mechanical properties of copper wire is produced entirely by manipulation and without the admixture of any alloy. Its electrical conductivity is practically the same as that of commercial wire drawn from the same ingots, the slight increase being due to the change in the molecular condition of hard copper.

Mr. Doolittle did not patent this valuable process of the manufacture of hard copper, which has extended the limit of electrical transmission of speech four times the distance available with iron wire and has been of incomparable value in other electrical service, and the award of the Edward Longstreth medal by the Franklin Institute in 1898 was an act of most suitable recognition of an invention which has been usefully applied to the service of mankind throughout the world wherever electric wires are spanned.

The relative cost of iron and copper wire is not a measure of the comparable expense of such lines in actual service, as copper does not have an oxide of high resistance, and its life has not yet been determined. The value of copper scrap from wrecked or reconstructed lines is about two cents a pound less than that of new wire, while galvanized iron line wire costs about four cents a pound.

The Electrical Equipment of the Bellevue-Stratford Hotel, Philadelphia.

FIG. 1.—BELLEVUE-STRATFORD HOTEL.

An electric plant that serves to indicate the magnitude of the electrical requirements of the modern hotel building has been installed in the Bellevue-Stratford Hotel, Philadelphia, a conspicuous eighteen-story, fire-proof structure recently completed on South Broad Street, on the corner of Walnut Street, a short distance from the City Hall. It is designed to supply about 13,000 lamps of 16 cp, 530 electric heaters for curling irons and 320 hp in electric motors, besides some 1,118 plugs for portable connections to the electric distribution system, together with a notably extensive system of call bells, fire alarm apparatus and telephones. The general proportions of the hotel and the typical arrangement of rooms on the guest floors is given in an accompanying illustration, which indicates the distribution of lights, and some noteworthy details are also illustrated, including the lighting of the palm garden and of the ball room. The figures given above apply to the building when fully completed, the rear ends of the three wings not yet having been continued above the ballroom ceiling.

The building was erected from the plans of Messrs. G. W. & W. D. Hewitt, of Philadelphia. The general mechanical and electrical engineering was placed in the hands of Francis Bros. & Jellett, Inc., engineers of Philadelphia, and the electrical equipment was installed by the George A. Fuller Co., which was also the general contractor for the building. The electric generating plant, in the sub-basement of the building, comprises four 250-kw, direct-connected sets, each consisting of a 23 x 42-in. Allis-Chalmers Corliss engine and a 115-volt, direct-current Western Electric generator. These are supplied with steam from five 302-hp Aultman & Taylor water-tube boilers, which are equipped with the Wilkinson mechanical stoker. The generating units take from the top of a 12-in. steam line which is extended around the entire engine room in a loop which forms a complete ring by connection into the opposite ends of a 12-in. header in the boiler room.

Electric Lighting and Power.

The typical floor contains 53 guests' rooms and 40 private bathrooms. All the guests' rooms are equipped with an electrolier in the center, containing from three to six lights each, and, as a rule, two wall bracket lights. The three-light chandeliers are in the rooms along the courts, four-light chandeliers are furnished in rooms along the side streets, these rooms being somewhat larger and more pretentious than the court rooms, four, five and six-light chandeliers are given to the rooms along the Broad Street front, while the two front corner rooms on each floor have a ten-light fixture with no wall brackets, these rooms being planned to serve as dining-rooms as a part of the suite with the adjoining bedchambers. In all cases part of the lights of every room are connected on one circuit and the rest on a second. Except the court rooms, these central lamps are controlled by two switches, one in general supplying one or two lamps of the fixture and the other supplying the remainder. These switches are located at the corridor door, the switches being 4½ ft. above the finished floor. The bracket lights are 5 ft. 3 in. above the floor and are 5 ft. apart. Two lights are provided over the basins in the bathrooms, the outlets being 7 ft. 6 in. high from the floor, with toilet bracket dropping lower. The clothes closet of each room is provided with a light which is controlled by a separate switch located inside of

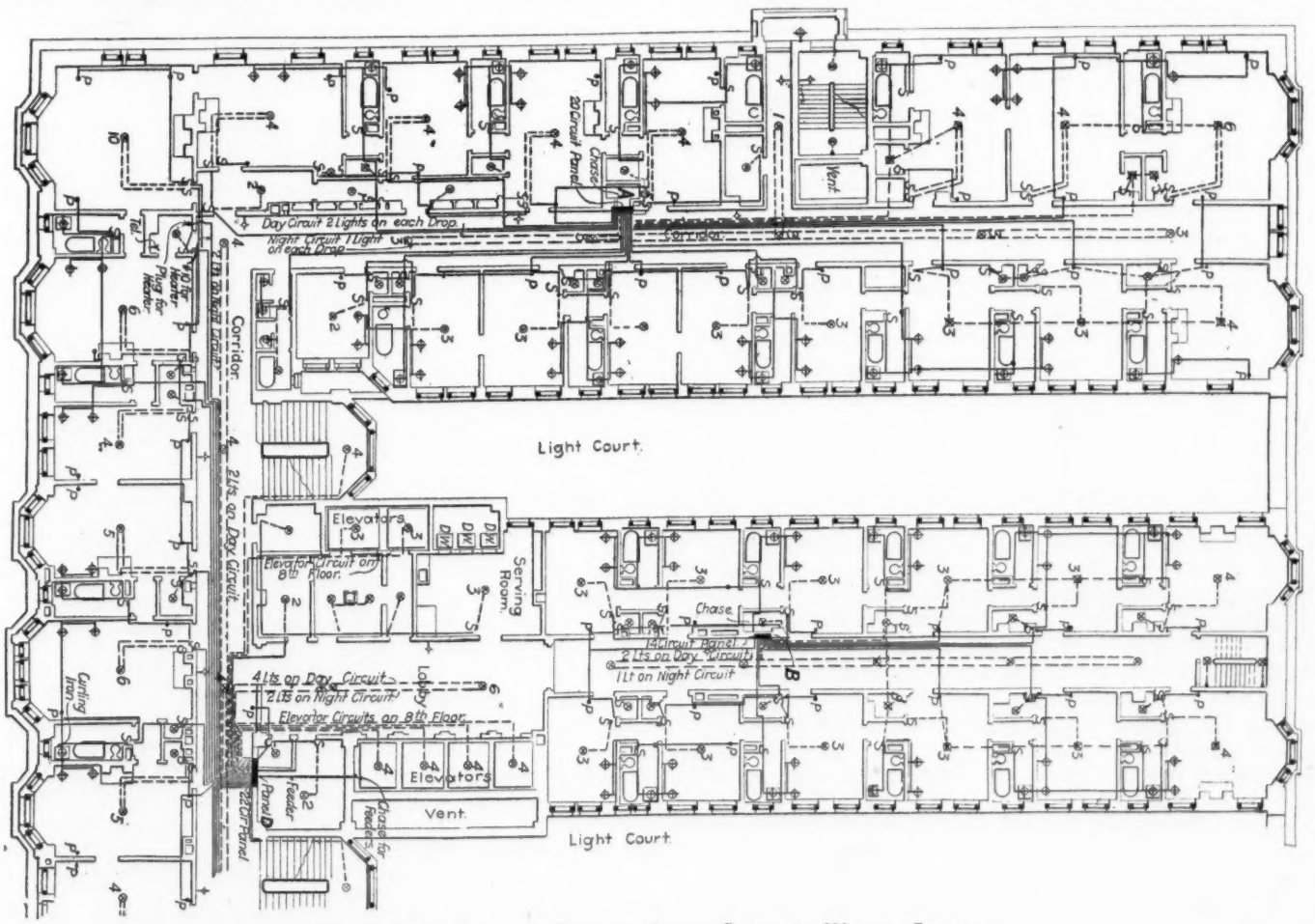


FIG. 2.—PART PLAN OF TYPICAL FLOOR, SHOWING WIRING SYSTEM.

closet. The more important rooms are provided with two plugs, while those along the courts have one plug.

The wiring of floors above the second is fed from four points, at each of which there is a panel box; below the second floor the wiring is fed from many distinct points. One of the four general rising

points is situated in the center of the front or main portion of the floor and supplies the entire front and the lighting of the elevator hall or lobby. The remaining three are each more or less centrally located in the three wings. The main panel, served from rising point D, distributes to 22 circuits on the typical floor, with four additional circuits on the eighth floor for the lights in the elevators. Each of the outside wings is served by twenty circuits, while for the central wing fourteen circuits suffice. The circuits from the panel boxes are run directly to the ceiling outlets and from these outlets the lines drop to the switches. Brackets and plugs are generally carried on separate circuits fed from the floor upward. The hall light circuits are, of course, carried altogether at the ceiling line, and are, as usual, arranged on two circuits, one for the night lights. The lobby at the elevators is supplied with six-light electroliers and the main corridor with four-light fixtures, in each of which two lights are connected on the night circuit and the remainder on the day circuit. In the wing corridors there are three-light fixtures, with one light in each case on the night circuit.

The total number of lights on the typical floor, not including con-

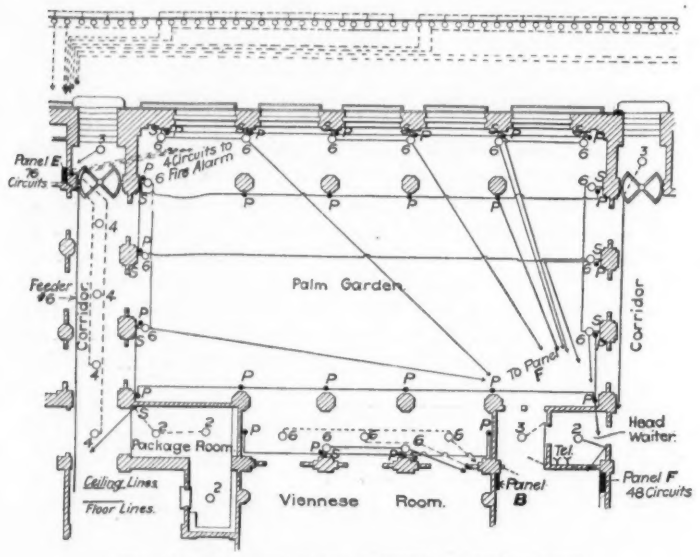


FIG. 3.—PLAN OF PALM GARDEN, GROUND FLOOR.

nections to the plugs, amounts to over 550, so that for the total floor area enclosed by the outside walls, there are about 47.4 sq. ft. of floor area per light. The total number of lamps in the guests' apartments on the typical floor; that is, not including the lighting of the halls and other public parts, is about 475, and for the 20,000 sq. ft., more or less of floor area comprised in guests' chambers and bathrooms, there are 41.5 sq. ft. of floor area per light. On the basis of the cubic contents of the entire building, assuming the total number of lights at 13,000, there are 600 cu. ft. of space per lamp of 16 cp.

Among the portions of the building where a high degree of illumination is provided is the palm garden which, it will be recalled, lies at the rear part of the main floor with a 20-ft. clear inside height which the rooms of the main story possess. It is approximately 47 x 80 ft. in plan. At every pilaster on three sides of the room, twelve all told, there is a six-light bracket, 5 or 6 ft. above the floor line. In the ceiling of the garden there are seven large groups of fifteen lamps each. This makes a total of 177 lamps of 16 cp or one lamp for 21 sq. ft. of floor area. At every pilaster around the four walls and at the columns rising through the room, there is a plug at the floor line for the attachment of local illumination on the dining tables. All the circuits are controlled from a panel box near an inside corner of the room and from this panel box there are also run circuits to the rooms adjacent to that end of the palm garden, this panel having 48 circuits altogether. The bracket circuits, as well as those to the plugs, are, of course, run at the floor line, while the others are supplied from the ceiling circuits.

Along the alley at the rear of the hotel and extending from the rear entrances on the side streets is a canopy under which vehicles may be driven to the rear entrances on the main floor. Lamps are spaced along the outside edge of the canopy at distances of about 26½ in. on centers. Ten circuits all told were required for the lighting of this canopy, and every other light is on one circuit, those in between being on another, so that the lamps alternate with respect to the circuit supply. The most distant lamp is probably 180 ft. from the panel box which controls it, this panel box containing 76 circuits and supplies also the illumination to the main entrance to the ball room, which lies at the opposite end of the palm garden from that referred to. It may be stated in passing that the upper part of the ballroom entrance is illuminated from four 23-light electroliers. Over the steps to this entrance and over that to the rooms at the opposite end of the palm garden is a canopy in each case lighted with lamps spaced about 13 in. on centers.

The ballroom, however, possesses the greatest concentration of illumination, having some 1,344 lamps for a room of about 8,150 sq. ft. of floor area, or one lamp for 6 sq. ft., or counting the gallery floor, an additional floor space, there is one lamp for 10 sq. ft. As already described, this gallery extends around all four sides of the room and underneath it; behind the columns which serve in part to carry the gallery, is a promenade on both the main and gallery floors. An accompanying plan of the upper portion of the room will serve to indicate the disposition of the lighting. In the cartouche over the caps of each of the columns, twenty all told, there is provision for fifteen lights in each case. In the cartouche in the ceiling panels there are sixteen outlets for twelve lights in each case, the relative location of these being indicated in the smaller of the dotted line rectangles. On the front of the boxes and the part of the gallery reserved for the orchestra there are twenty-nine outlets for twelve lights each. In the cove of the cornice around the room there is a continuous rectangle of lights, 220 all told, controlled alternately with respect to the circuits supplying them. Behind the columns in the gallery there are sixteen eight-light bracket outlets and two ceiling outlets at opposite ends of the room, also for eight lights each. This makes a total of 1,204 lights in the upper part of the room. Under the gallery fourteen of the columns are provided with eight-light brackets, there are two eight-light fixtures underneath the orchestra and a twelve-light ceiling fixture at the opposite end of the room under the gallery, making a total of 140 lights, or a grand total for the room of 1,344 lights.

The orchestra portion of the gallery is designed to be lowered toward the floor line, as already mentioned, to serve as a stage for dramatic entertainments, and for this purpose it is equipped with vertical screws by which it is raised and lowered as desired. This

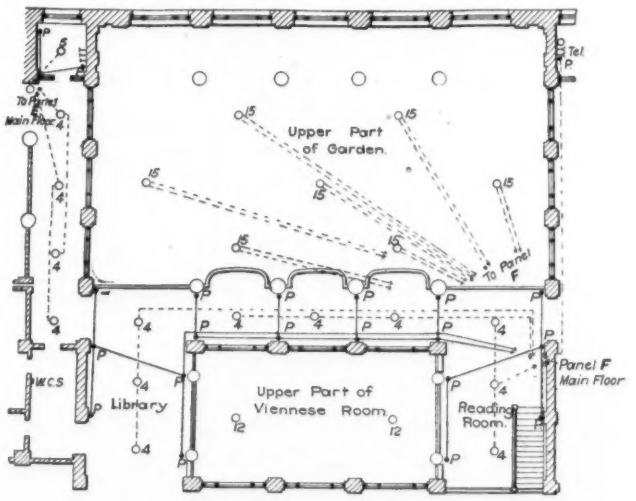


FIG. 4.—UPPER PART OF PALM GARDEN.

fact has made necessary the provision of plugs for illuminating the front when it is in its up position as the orchestra's gallery and for supplying foot and border lights when it is utilized as a stage. In the latter position it is to be furnished with a false front in which will be arranged the footlights with circuits for the different colored lamps that may be employed, and there are three circuit plugs at the bottom of the column on each side for this purpose and also three three-circuit plugs for the border lights. At the gallery opposite the stage are two 50-amp. plugs provided specially for operating an electric lantern for projecting light upon the stage.

The ballroom has a complete stage switchboard. It is of white Italian marble, and controls the entire ballroom lighting. This board is made up in two sections: (1) the switchboard proper, standing immediately in front of (2) the panelboard section. All circuits are carried directly back to the panelboard section and there individually fused and grouped, and the feeders are carried over to the switchboard. Each group of lights has a switch and a dimmer, the

dimmer handle being located directly above the switch. The dimmers are of the Wirt universal interlocking type, with the resistances mounted on a separate slab back of the board and operated by bronze cables run from the levers to the resistance grids. The levers are arranged in four banks, one for each of the three colors on the stage —red, white and blue—and one bank for the auditorium. Each dimmer circuit has a pilot lamp directly above, arranged in the form of a receptacle set so that the lamp comes flush in the marble. A hand wheel for slow motion is provided for the dimmers. Few theatres in the country have a more complete switchboard than is here installed.

The total motor-connected load aggregates 320 hp. Most of this is comprised in the heating and ventilating equipment, where, as already stated, there are 20 fans requiring a total of 194 hp in the motors to drive them. Besides these there are five motors aggregating 62 hp in the laundry (including a 55-hp Sprague motor driving shafting by belts), a 15-hp Diehl for driving the Exeter coal conveyor and the following miscellaneous equipment: 4.7 hp for a motor-generator in connection with the bell and fire alarm system; two 3-hp motors for ice cream freezing; three motors aggregating 4 hp for the silver buffers; two 5-hp motors for dish washing machines; one 3-hp motor for the butcher shop and one 1-hp for the electric pump supplying distilled drinking water. The fan motors throughout were built by the Diehl Manufacturing Company. Each motor is supplied through a small panel located near it and on this panel is mounted a double-pole fuse switch and single-pole circuit-breaker.

Incandescent lamps of 110 volts are employed practically throughout the building, but a number of enclosed arc lamps for this voltage are in use, mostly in the laundry. This room, located in the sub-basement, has an area of over 6,500 sq. ft. and is illuminated from twelve arc lamps of this character, furnished by the Jandus Electric Company, so that there are 543 sq. ft. per arc. In addition to these lamps there are, however, fourteen incandescent lamps, but these are mostly suspended on flexible connections for local lighting at the various laundry machines. Each arc is on a separate circuit.

The feeders were calculated on the basis of about 0.55 amp. per lamp, 1½ amp. for each curling iron heater and 8 amp. per hp of the motors; generally a pressure drop of 3 volts is allowed for. The notable exception is the calculation for the feeders to the lighting of the general floors from the second to the sixteenth inclusive, and

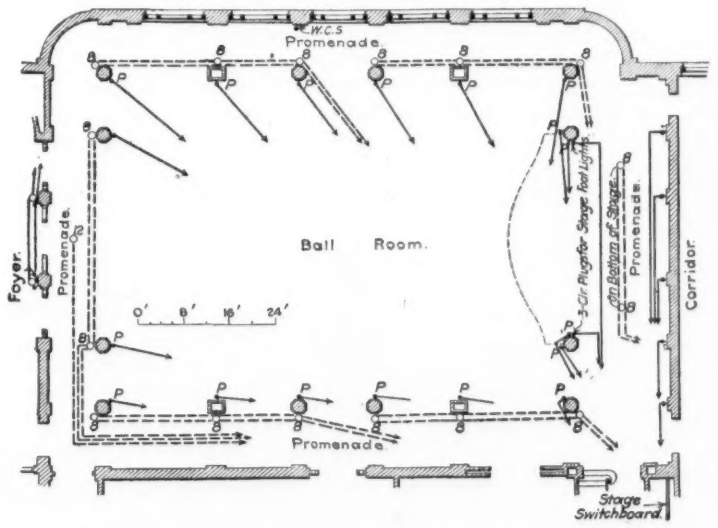


FIG. 5.—PLAN OF BALLROOM, FIRST FLOOR.

for the feeders to motors. Here, in every case, 5 volts' drop was allowed. Branch circuits were given 2 volts' drop. The assumed working conditions and some of the characteristics of the lighting feeders are given in the accompanying table. In each of the four rising points there are three feeders, each feeder supplying the lights on five floors. Each feeder is run, in the usual way, to the central floor of the group it supplies, and sub-feeders connect up and down with the corresponding panel boxes for the other floors of the group of the five in question. The single distance of the central box from the switchboard is noted for each feeder, the cross-section of each of the pair of conductors, the size of the pipe through which each wire is carried from the switchboard to panel box, two pipes per feeder, and the ampere load on which the calculations are based, the load being the largest possible with allowance for additions. Aloricated conduit was employed for carrying the circuits, and Simplex wire was used.

Table of Lighting Feeders for the Upper Floors.

No.	Single length, ft.	Cross-section, cir. mils.	Pipe size, in.	Floors inclusive.	Amperes.
Riser Point A.					
10	225	700,000	2	2-6	500
11	285	750,000	2	7-11	533
12	350	750,000	2	12-16	483
Riser Point B.					
15	190	400,000	1½	3-6	308
16	260	500,000	1½	7-11	371
17	325	550,000	2	12-16	335
Riser Point C.					
30	185	750,000	2	2-6	515
31	250	750,000	2	7-11	533
32	315	700,000	2	12-16	483
Riser Point D.					
21	140	700,000	2	2-6	545
22	205	750,000	2	7-11	525
23	270	700,000	2	12-16	499

The generating plant, it will be recalled, comprises four 250-kw units. The dynamo leads are of paper-insulated, lead-covered conductors and run directly to the main switchboard under the engine

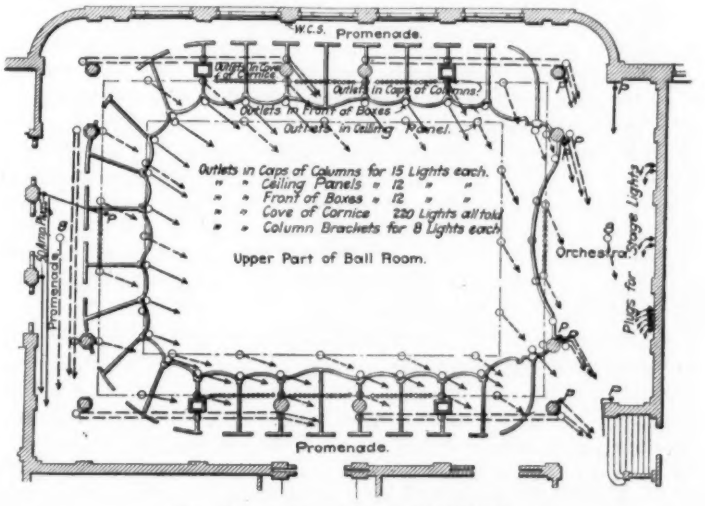

W.C.S.
Promenade.
Outlets in Cove of Cornice
Outlets in Caps of Columns
Outlets in Front of Boxes
Outlets in Ceiling Panel.
Outlets in Caps of Columns for 15 Lights each.
" " Ceiling Panels " 12 " "
" " Front of Boxes " 12 " "
" " Cove of Cornice 220 Lights all told
" " Column Brackets for 8 Lights each.
Upper Part of Ball Room.
Promenade
Orchestra
Plugs for Stage Lights
Promenade.

FIG. 6.—UPPER PART OF BALLROOM.

room floor. The switchboard is arranged with the generator connections in the center and the feeder panels at each end. Altogether it is 29 ft. in length and 7 ft. 6 in. high. The power section of the switchboard is not separate and distinct from the lighting side, but the switchboard is arranged practically symmetrical on each side of the generator section. It was originally laid out to have the power supplied from one side and the lighting supplied from the other, but there being no manifest benefit arising from this arrangement, the scheme was abandoned and the board made symmetrical. The connections of the four generators are grouped on three panels. Each main switch is of the three-pole, single-throw type, thereby including the equalizer connection, and the four switches are arranged in a horizontal line across the middle of the panels, two switches on the middle panel and the line of four flanked on each end by a recording wattmeter, one wattmeter for registering the flow of current to one-half the board and the other for registering the current to the other half. An ammeter is provided for each machine at the upper part of the panels, and there is a circuit-breaker below each switch. In addition to the ammeters there is a voltmeter with multiple-point switch, a ground detector and a differential voltmeter. All the feeders are connected through double-pole, single-throw switches and each is provided with an I.T.E. circuit-breaker made by the Cutler Electric Company, all except the smaller ones being of the laminated type. At each end of the switchboard there is a bracket voltmeter.

The feeders are carried vertically upward from the switchboard into a junction box at the ceiling line behind the board, where a rearrangement of the feeders is made, so that all its exposed work presents a good appearance. The junction box is approximately 3 x 3 ft. in cross-section and of the length of the switchboard and is constructed of 1½-in. oak furnished with a paneled bottom hinged and fitted with locking clamps. From the junction box the feeders run in conduit to the various rising points. As already stated, the feeders consist of two wires, each in a separate tube. The panels throughout the building are set in oak cabinets 1 in. thick, with doors of plate glass. Cartridge fuses are used throughout.

The Annunciator System.

On the main floor is located the main annunciator. This annunciator is of the Patrick, Carter & Wilkins needle type and has 945 drops, divided up into fifteen sections. One section takes care of everything below the second floor; another section is provided for each floor from the second to the fourteenth, inclusive, and the last section has indications for the fifteenth and sixteenth floors, which are combined. On the lower floors buttons indicate directly on the main annunciator only. On the room floors an annunciator of about 64 points is provided in each of the floor offices. Each of these annunciators is in multiple with its corresponding section of the main annunciator, so that both indicate at once. The main annunciator has an indication on each section operated from a button on the corresponding floor office annunciator, showing the call has been answered from the floor office, and each section of the main annunciator is correspondingly arranged to show to the floor office attendant that the call has been answered from the main office. Each floor office annunciator has a button board directly below it and made a part of the annunciator. This button board controls an annunciator of the same size as the floor office annunciator, located in the pantry of the corresponding floor.

The system of wiring for the bell system is conduit throughout; the buttons are grouped together five or six on one line, and carried back to a junction immediately back of the floor office annunciator. From here the multiple lines are carried together with the indication wires to the pantry annunciator, and passed down the wire shaft to the main annunciator. From this point they are supplied with battery by means of trunk lines from the bell power switchboard in the sub-basement. Each section of the main annunciator, and, of course, the corresponding floor annunciator, is supplied with a separate battery wire, controlled by a switch on the bell power board, so that it is possible to cut out any section without interfering with the rest of the service.

The bell power switchboard is quite an affair. It is divided into four panels; one panel has the feeder switches through which current is supplied to the bell system, fire alarm system, etc. The second panel has the meters, breakers, starting boxes, field rheostats and motor and generator switches for the two motor-generators, supplying the entire bell and fire alarm systems. The next panel provides the instruments and apparatus for the two motor-generators supplying the elevator signaling device. The fourth panel is similarly arranged for the control of the motor-generator, which supplies current to operate the valves of the pneumatic tube service. In addition, upon this panel are located the breakers and switches for the storage battery. The board is arranged by means of double-throw switches, so that either of the motor-generators or the storage battery can run the bell system, or the battery can be charged, or any desired combination can be made.

Fire Alarm System.

In the office on the main floor there is an 80-point annunciator which indicates from fire alarm boxes distributed through the building. On the room floors are four boxes, one in the center of each wing, and one in the center of the front corridor. On the other floors they are located at various necessary points. Immediately above each box is placed an 8-in. vibrating bell. The breaking of a glass on one of the boxes sends in an alarm to the annunciator in the main office. This, however, does not start the large bells. These are operated by four sets of rotating switches located in the annunciator. One switch rings bells in the upper part of the building, another switch operates the lower floors and the other switches the middle section. When an alarm comes in from any box, the office thus has a chance to investigate and to avoid turning in a false alarm which is a very serious matter in a large public building. The current for operating the fire alarm system is supplied from the bell power system in engine room.

Watchman's Clock System.

The watchman's clock system is a magneto system, and consists of a Holtzer-Cabot clock, operating from 75 stations located throughout the building. This system being entirely magneto, requires no external battery.

Telephones.

The telephone system in this building is more extensive than in many large-sized towns. The wiring throughout is in conduit, five or six 'phones being grouped on a circuit or line. These lines carry back to a main junction on each floor near the passenger elevators. From this point the trunk lines are run to the main switchboard. The conduit system is arranged for one main switchboard, of about 1,000 drops. Sixty-nine 'phone outlets for the use of officers and executives of the building are grouped to a central point, so that it would be possible to install a small exchange for these particular 'phones. There are also many direct 'phones between various points requiring direct service. In the bedrooms the 'phones are of the desk pattern, and are connected from a plug in the washboard, so that the 'phone may be carried anywhere in the room. This arrangement also applies to many of the other 'phones; in fact, there are few wall 'phones in the whole installation. The Bell Telephone Company is now operating the system, and has installed a switchboard with provision for 1,000 drops.

Recent Electrochemical Developments.

ELECTRIC FURNACE PROCESS.

For several years various inventors have been interested in the manufacture of various articles of fused silica (quartz).) The fact that silica which has once undergone fusing is practicably non-expansible is a property which enables it to be applied to many uses; a well-known experiment is to heat fused quartz tubes in a Bunsen burner and then pour water into it to show that it will not crack. The chief drawback to the more extended use of such fused quartz articles has been in the past the high price, due to the difficulty of manufacture. Heraeus is manufacturing these articles in a lengthy process by means of the oxyhydrogen flame. R. S. Hutton suggested, in an American Electrochemical Society paper several years ago, the use of the electric arc for fusing quartz. In a patent recently granted to Elihu Thomson is used a resistance furnace somewhat similar in general design to Acheson's carborundum furnace.

Thomson uses a carbon core embedded in quartz granules or silica in comminuted form. Upon the passage of a very strong heating current through the carbon conductor the quartz in the immediate vicinity of the conductor is melted, so that, upon the cooling of the conductor a body of fused quartz following the contour of the conductor is obtained. The length of time during which the current passes determines the depth to which the fusion takes place about the heating rod, and therefore the thickness of the silica tube which results. When more complicated forms of apparatus are to be made, there is no difficulty in making the different parts separately and fusing them together, since the heat may be applied to them as suddenly as desired without any danger of cracking.

Henry M. Howe, the well-known steel authority of this country, patents an electric laboratory furnace which should be specially useful for determining the cooling curves of steel, or for callibrating thermocouples by means of the melting points of metals, or in general for laboratory work where it is desired to reach quickly and accurately a desired temperature. The furnace, as shown in Fig. 1, consists

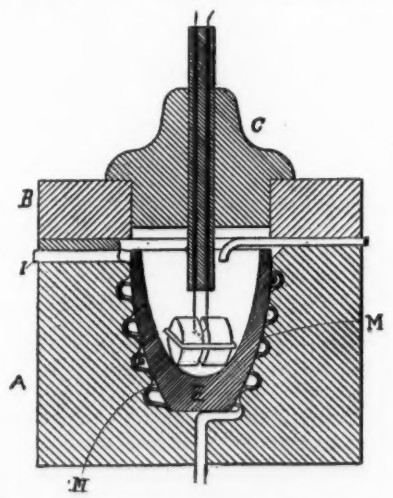


FIG. 1.—ELECTRIC LABORATORY FURNACE.

of a block, *A*, of magnesia hollowed to form a heating chamber, with a spiral groove, *M*, in the inner face of this chamber, in which the platinum heating wire is embedded. Within this chamber is inserted the magnesia crucible, *E*, so that the spiral platinum wire lies between the inside magnesia crucible, *E*, and the outside magnesia block, *A*. The furnace is closed at the top by a stopper, *C*, of magnesia, through which a thermocouple is inserted.

D. R. S. Galbraith patents an electric furnace for the reduction of

iron sand or the treatment of other pulverized material. The special feature is the arrangement of the fusing zone of the furnace whereby the shower charge of the powdered material under treatment is deflected by non-conducting bauxite interceptors crossing the fusing zone, and is thus repeatedly caused to close an electric circuit, whereby on account of its high resistance it is raised to incandescence.

ELECTROLYTIC PROCESSES.

A very interesting new type of diaphragm cell for the electrolysis of aqueous solutions of chlorides of alkalies is covered by two patents recently granted to Clinton Paul Townsend. The essential new feature is the provision of a liquid in the cathode compartment which is immiscible with and inert toward the hydroxide formed at the cathode. As an example of such liquids, the inventor mentions the non-saponifying oils.

The construction of the cell is shown in Fig. 2, where is the anode of Acheson graphite, 3 the cathode compartments, 4 the cathodes,

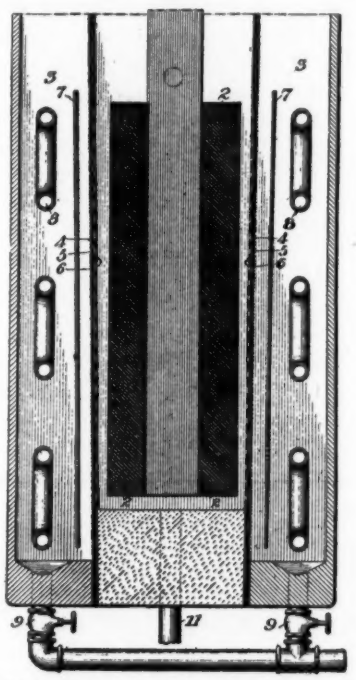


FIG. 2.—DIAPHRAGM CELL FOR SODIUM CHLORIDE ELECTROLYSIS.

6 hard rubber supports for the diaphragms, 5, which are placed between 4 and 6. By means of heating or cooling coils, 8, the temperature may be regulated; 7 are inert iron plates. The sodium chloride solution is introduced through 11 and a continuous flow is maintained upward through the anode compartment, while the cathode compartment, 3, is filled to or above the top of plate 7 with the immiscible oil mentioned before. The chief object of the oil is to effect the positive removal of the sodium hydrate formed from the electrode. Since the oil adheres closely to the electrode, the caustic solution, being unable to displace the oil, assumes at once the form of globules and freely detaches itself. It is thus formed and collected under seal of the oil so that the formation of carbonates from contact with the air is prevented. The removal of the caustic from the cathode is further aided by the strong stirring effect of the hydrogen gas bubbles simultaneously set free at the cathode and passing upward in the space between the cathode and the iron plate, 7. On account of the quick removal of the product formed at the cathode from the sphere of electrolytic action it is possible to employ current densities equal to or exceeding one ampere per square inch of cathode. During the relatively slow downward movement of the oil in the large compartment between the iron plate, 7, and the external cell walls, the caustic carried by the oil separates therefrom and is deposited in the lower portion of the cell from which it is withdrawn by the tubes, 9. The process has been worked out undoubtedly with due regard to the most fundamental principle in the design of apparatus for electrolysis of sodium chloride for the production of caustic soda and chlorine—that is, the necessity of removing the products from the electric circuit as soon as formed.

P. G. Salom's process for producing lead from galena has been in use on a large experimental scale at intervals during the past years in Niagara Falls. The reaction is cathodic reduction of lead sulphide with sulphuric acid as electrolyte. The first apparatus used by Salom consisted of a series of dishes placed one above the other; this had the great disadvantage that the process required much handling of materials since the apparatus had to be taken apart after each reduction process. The inventor has now made his process continuous. He uses an annular electrolytic cell of which the bottom forms the cathode plate, and which is continually revolving. A thin layer of lead ore is continually spread upon the bottom plate and when reduced the spongy lead is scraped off, both the supply of ore and the removal of the lead being automatic by means of the rotation of the cell.

A patent recently granted to A. G. Betts refers to an important detail of his well-known lead-refining process. In order to prevent crystallization of the deposit and to get a dense and homogeneous deposit he adds a quantity of a reducing agent, like gelatine, to the electrolyte of a lead salt of a fluorine acid.

I. L. Roberts patents a method of producing metallic magnesium, the principal feature being the composition of the electrolyte, which is a mixture of magnesium fluoride and of chlorides of the alkali metal group. This mixture becomes liquid at dull red heat and is then electrolyzed in an atmosphere composed of the gases produced by the electrolysis. In this way volatilization of the bath is said to be prevented.

W. T. Gibbs patents a method of treating alkaline solutions of chromate of soda (the leach liquor, which is produced in the present method of making bichromate of soda by the extraction of chrome—milk with water). The process is intended especially for use in manufacturing bichromate of soda, while bicarbonate of soda also may be produced. It consists in treating the solution first with carbonic acid gas and then electrolyzing the resulting neutral solution of chromate of soda so as to separate it into a solution of bichromate of soda and into one of chromate of soda and free alkali.

A. Frank patents a method of producing hydrosulphites of alkaline earth metals or of earth metals by electrolyzing a practically neutral solution of the bisulphite of the respective metal in the cathode compartment of a diaphragm cell, while the anode compartment contains a solution of a compound of an alkali metal.

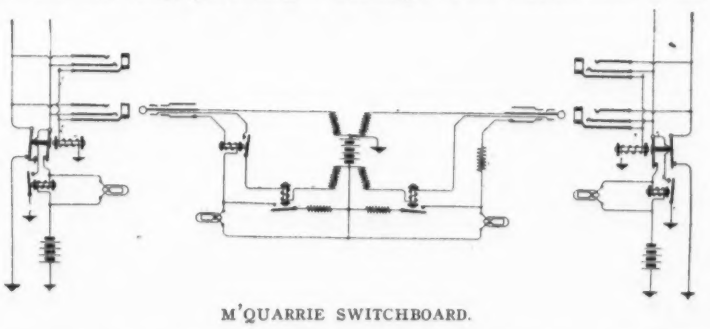
E. G. Case patents a method of applying an abrasive substance like carborundum or emery on a metallic surface to get grinding or polishing surfaces. The carborundum powder is distributed over the metallic surface with simultaneous metallic electrodeposition so as to embed the grains of carborundum within the metallic deposit.

We noticed last year in these columns a patent for using calcium carbide electrodes in electrolytic processes in which the carbide is to react with the products of the decomposition of the electrolyte. Since it is difficult to obtain pieces of calcium carbide of sufficient size and uniform composition for use as electrodes, E. F. Price has recently patented the construction of electrodes made of calcium carbide and a binder. A coked hydrocarbon or carbonaceous substance, such as bituminous coal, is recommended as binding agent.

New Telephone Patents.

ANTI-CLICK CIRCUIT SYSTEM.

A central energy switchboard circuit system, especially arranged to avoid the disagreeable clicks or sound shocks so prevalent with some present systems, is illustrated below. The system in its main principles is that standard with the Bell Companies. With such a system the worst clicks occur when the cut-off relay operates to cut off the line relay, permitting a discharge of the various coils in the



M'QUARRIE SWITCHBOARD.

line, and also when the plug, while being inserted in the jack makes certain temporary false connections. To avoid these difficulties the line relay is arranged in the improved circuit not only to cause the lamp to glow, but to short-circuit the line, until after the cut-off relay has operated. The short-circuit eliminates the effects of dis-

charges. The effects of false connections are overcome by an auxiliary relay which withholds the battery connection from the plug until this is finally pushed home. Mr. J. L. McQuarrie is the inventor of this circuit, the Western Electric Company having obtained the patent by assignment.

TWO-CELL TRANSMITTER.

Another two-cell transmitter has appeared, this the invention of Mr. O. M. Frykman, of St. Paul, Minn. The transmitter is to be used in combination with an induction coil with a two-part primary, one transmitter cell being associated with each primary. The transmitter diaphragm effects an increase of the resistance of one button and a substantially equal decrease of the resistance of the other. The primary windings of the coil are connected up in opposition and the magnetization of the induction coil core is thrown to either side of the neutral or balanced condition following the changes of resistance of the two transmitter buttons.

LETTERS TO THE EDITORS.

A Comparison of Alternating-Current Railway Systems.

To the Editors of Electrical World and Engineer:

SIRS:—I beg to call to your attention a mistake made by your printer in connection with my article, "A Comparison of Alternating-Current Railway Systems," which appeared in your issue of January 14. Referring to page 99, second column, beginning with the paragraph above the illustration, Fig. 2, this and the two following paragraphs should read as follows:

"*System* 1.—The polyphase alternating-current, high-voltage transmission system in conjunction with the direct-current, low-voltage distribution system, with sub-stations and direct-current locomotives. This system is now being installed for the New York Central Railroad. (See Fig. 1.)

"*System* 2.—The three-phase, alternating-current, high-voltage transmission system in conjunction with high-voltage, three-phase distribution system and high-voltage locomotives with three-phase induction motors. This system is in practical operation in Europe. (See Fig. 2.)

"*System* 3.—The polyphase or single-phase, alternating-current, high-voltage transmission system in conjunction with high or low-voltage, single-phase distribution system and high or low-voltage, single-phase locomotives, equipped with single-phase, alternating-current commutator-type motors, geared to the axles. This system has not been tried on a large scale. (See Fig. 3.)"

NEW YORK CITY. J. H. HALLBERG.

German Patents on American Inventions.

To the Editors of Electrical World and Engineer:

SIRS:—In the issue of your paper of January 7 I notice a letter concerning "German Patents on American Inventions," and I can only corroborate the statement, made by Mr. Thompson, from my own experience, as in the capacity of an attorney for foreign patents I take out a great many German patents every year. Outside of my own experience, I am in the position, however, to place the following official figures before you. The percentages of applications allowed to German and United States inventors during the years 1899 to 1903 were as follows:

	German Inventors.	U. S. Inventors.
1899	32.4 per cent.	50 per cent.
1900	37.3 per cent.	49.3 per cent.
1901	37.5 per cent.	62.4 per cent.
1902	34.1 per cent.	60.8 per cent.
1903	30.9 per cent.	54.9 per cent.

NEW YORK CITY. ALFRED MÜLLER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Electromechanical Voltage Regulator.—BROCK.—An illustrated description of the electromechanical regulation system of Rontin for automatically adjusting speed and voltage with varying load, so that for increasing load and decreasing voltage simultaneously the output of the steam engine and the excitation of the dynamo are raised. The arrangement is shown in Fig. 1, where G is a direct-current,

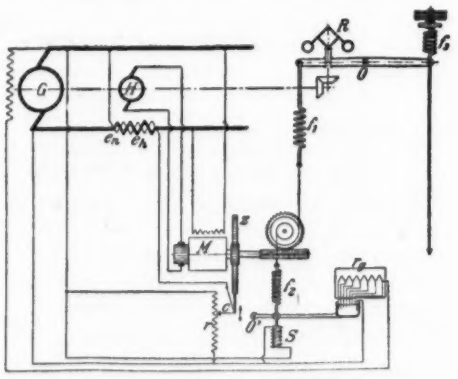


FIG. 1.—VOLTAGE REGULATOR.

shunt-wound dynamo, r_g is a regulating resistance in the shunt winding of this machine, H is the armature of a small auxiliary dynamo which is continually held in rotation, for instance by the prime-mover driving the main dynamo; eh and en are the exciter windings of H and counteract each other; eh is supplied with the total current of G, while the current through en is variable and depends upon the position of the contact C on the rheostat, r, connected in shunt with the terminals of the generator. M is a motor, the armature of which is supplied with current from the auxiliary dynamo mentioned above, while its exciting circuit is connected across the mains. By the motion of this motor armature the gear z is acted upon and causes a displacement of the contact C. At the same time a worm gear acts on the springs f_1 and f_2. The lever on which the centrifugal regulator, R, acts, can revolve around O, and the spring, f_3, counteracts the attraction of R on the lever. The terminal of the lever is provided with a rod which controls the steam admission for the prime-mover. S is a solenoid connected to the terminals of the generator. The iron core of S is connected to a lever which revolves around O'. The spring, f_2, counteracts the magnetic attraction of the iron core. At no load the contact, C, is situated at the top of r, so that no current flows through en. The rheostat, r_g, has its whole resistance inserted, corresponding to the no-load voltage. It will be seen that at no load the auxiliary dynamo is not excited and that therefore no current is supplied to the motor, M. When the machine is loaded current flows through eh and the motor is supplied with current and is set into motion. This acts on the two springs, f_1 and f_2, resulting in an increased admission of steam and increased excitation. At the same time contact C is moved downward, so that a current begins to flow through en, which increases until the ampere-turns of en are equal to those of eh. When this takes place, the auxiliary dynamo is without current and the motor is at rest.—*Elek. Zeit.*, December 22.

High-Frequency Alternator.—DUDDELL.—An abstract of a British Physical Society paper, in which the author describes a high-frequency alternator which he has constructed for some experiments on the resistance of the electric arc, and with which frequencies up to 120,000 periods per second may be obtained. The alternator consists of an inductor, built up out of ferrotype plate, having V-shaped notches cut in its edge so as to have flat-topped teeth. Surrounding the indicator is a laminated ring having two inwardly projecting poles, the clearance between these and the teeth of the inductor, which form the air-gap, being less than 0.1 mm. The ring is wound so that a direct current flowing round the winding tends to produce lines of force from one pole to the other through the inductor. The number of lines of force varies from a maximum when the teeth of the inductor are opposite the poles to a minimum when the pales are in front of the spaces. This variation in the total number of lines of force produces alternating e.m.f's in any winding either on the one-pole pieces or on the ring itself; the movement of the inductor through the distance between two consecutive teeth pro-

ducing one complete period. One winding on the ring may serve to carry both the direct field current which magnetizes the ring and the alternating current produced. In practice, owing to the great importance of any self-induction in the alternating-current circuit, it is advisable at high frequencies to use separate windings for the two currents. At the highest frequencies the best results are obtained with coils having a few turns of wire fixed right on the tips of the poles. The alternator is driven by means of a figure-eight belt driven from two phosphor-bronze discs. Each of these discs is belted to a double-grooved pulley, fixed on the shaft of a direct-current driving motor. With this method of drive, the inductor was run for several months at speeds between 30,000 and 40,000 r.p.m., and the spindle of the inductor alone could be easily run at 60,000 r.p.m. Using inductors having 30, 60, 90 and 204 teeth, the author obtains small alternating currents having frequencies from a few hundred periods per second up to 120,000 periods per second. An idea of how high a frequency of 120,000 periods per second really is may be obtained by plotting curves for ordinary frequencies of 50 to 100 per second on a scale of 10 in. for 100 periods, while to plot a curve up to 120,000 periods per second to this scale, the curve paper would require to be nearly one-fifth of a mile long. Many difficulties were encountered with the centrifugal forces on the driving belt, and the author finally obtained the best results with a spliced cotton cord. During the construction of the alternator, bicycle wheels were used to drive it, and it requires a very large power taken to drive these wheels owing to air friction. In the discussion Fleming said that for use in wireless telegraphy it would be necessary to use machines of a far greater output than the machine of Duddell. The difficulty with most high-freqpency alternators is the magnetic leakage. Many of the high-frequency alternators made had their power overestimated.—Lond. *Elec.*, December 30.

REFERENCE.

Compensated Alternating-Current Generators.—WALKER.—A long illustrated account of his paper on compensated alternating-current generators, a shorter abstract of which was recently noticed in the Digest.—Lond. *Elec. Rev.*, December 30.

POWER.

Electric Power in Scotland.—An illustrated article on two Scottish electric power schemes. One is the Fife Electric Power Company, the actual area to be covered being about 500 sq. miles in extent and including about 50 local authorities. There will be five power houses, only one being erected at the outset. It is anticipated that in the course of a very few years some half dozen or more large stations will be running. Each of these works has been designed with a view of accommodating 60,000 hp, but in order to meet local demands a smaller pilot station is being erected. This is described in detail. It contains two 500-hp and one 1,200-hp engines coupled to alternators generating two-phase currents at 3,000 volts, with a frequency of 50 periods. Two 75-hp engines drive the direct-current exciters. The greater part of the area of the Scottish Central Electric Power Company lies on the opposite side of the Firth of Forth and covers approximately 400 sq. miles. Three generating stations are scheduled of which one is now being constructed. The above two schemes are of considerable importance in view of the fact that they are situated in the center of a vast coal field, and are surrounded by a large number of works carrying on industrial processes. The schedule of prices which the Fife Electric Power Company is issuing to possible consumers is as follows:

Quantities.			per kw-hour.
Under 100,000	kw-hours per annum.....	3.	cents.
100,000 to 200,000	"	2.75	"
200,000 to 300,000	"	2.5	"
300,000 to 500,000	"	2.25	"
500,000 to 750,000	"	2.	"
750,000 to 1,000,000	"	1.75	"
1,000,000 to 3,000,000	"	1.5	"

These prices are for polyphase currents from the company's mains, transformed to any standard pressure required by the consumer.—Lond. *Elec.*, December 2.

Dust Destructor and Electricity Works.—ADAMS.—A paper read before the British Institution of Electrical Engineers, in which the author discusses the economical problem of the combination of dust destructors and electricity works. He gives, in form of a series of curves, some remarkable figures obtained in some undertakings, as evidence that great advances have been made in the problem of utilizing waste heat from burning refuse in destructors since the pioneer works were started. But these results still leave room for substantial improvement: First, by closer attention to the details of construction of furnaces and flues and the general arrangement of the plant; second, by improving the methods of handling and burning the refuse; third, by careful utilization of the steam generated and the adoption of an economical form of blast. Given suitable conditions, there is without doubt a substantial gain to be effected by the combination of electricity and destructor works, but owing to the variation in the calorific value of refuse in different localities, and to other special local considerations, every proposed case of combination needs to be considered on its merits by persons qualified to make an independent and intelligent inquiry. The various and in some cases crude methods in vogue of adjusting accounts between the two works need to be systematized, and it is highly desirable that the results obtained be separated and recorded with accuracy, so as to give so far as possible a true record of the financial position of both works.—Lond. *Elec.*, December 16, 23, 30.

TRACTION.

Current Through Rail Joints.—HEILBRUN.—An account of experiments in which the resistance of a tramway rail was measured by applying to points near the ends of the rail pointed terminals leading to the measuring instruments. It was found that such measurements with comparatively small contact points do not give the correct value of the rail resistance, since at the points where the current passes into or out of the rail it does not pass through the whole cross-section of the rail, but is forced into a much smaller section on account of the small section of the contact. This fact is of importance for the resistance of rails when joined together by rail bonds. These wires soldered to the rails at the sides must distort the path of the current near the terminals of the rail considerably. This fact causes a considerable increase of the total resistance of the rails. The author does not think that fishplates can help much. An effective remedy would be the production of a continuous rail as obtained by welding with thermit.—*Elek. Zeit.*, December 22.

REFERENCES.

Running Powers.—SELLON.—A paper read before the British Tramways and Light Railways Association, dealing with the legal conditions in Great Britain. "The justification of compulsory running powers is, of course, the public necessity. It ought not to be tolerated that parties entrusted by Parliament with tramway powers should be permitted by unreasonable conduct to prevent or hinder the full public use and advantage of any means of connection."—Lond. *Elec.*, December 9.

Brussels.—An illustrated description of the new power station of the Brussels electric tramways. There are at present installed four steam-driven generating groups, each with a normal output of 1,500 kw at 6,600 volts, the frequency being 25.—*Power*, January.

Automatic Reversible Booster.—Fig. 2, on page 45 of our last issue represented the arrangement of the automatic reversible booster, described in the abstract on page 46.

WIRES, WIRING AND CONDUITS.

Cables.—An editorial note and a communication by Perry on cable laying. Fifteen years ago vulcanized india rubber was employed almost exclusively for electric mains in England, and the manufacturers of lead-covered cable had some difficulty in persuading customers that lead-covered cables would be more durable. In fact, at first the durability of india rubber was hardly called in question, and thus lead-covered cables laid directly in the ground were introduced to compete in price with rubber-insulated cables drawn into iron pipes. The drawn-in system continued as chief favorite, however, until the first bad troubles occurred from explosions of gas which had got into the manholes and junction pits and circulated through the pipes or conduits. These accidents gave an impetus to the "solid" system, but recent events have shown that this system may have its defects also. On the mains of one of the London companies, an explosive gas was given off by the bituminous composition surrounding the cables, when faults were burnt out, and this gas even spread to the surface boxes of another company and caused explosions in them. This effect may be almost eliminated, however, by greatly reducing the unoccupied space in the boxes. Another possible effect in the "solid" system is pointed out by James Perry. He has observed cases in which the bitumen composition does not cling around

the lead of the cable, and thus may allow a film of moisture to surround the lead covering in some places. He suggests that tarred sand might take the place of the bitumen. It must be remembered that an extremely good insulator is not needed for this purpose, the chief function of the compound being merely to protect the lead of the cable from chemical action of the soil and moisture. Tarred sand would also doubtless be far cheaper than bitumen.—Lond. *Elec.*, December 30.

ELECTROCHEMISTRY AND BATTERIES.

Electric Resistance Furnaces.—FITZ GERALD.—A fully illustrated article on miscellaneous accessories of resistance furnaces. The change in temperature in the resistor necessitates some method of varying the voltage if it is desired to use a constant power throughout the working of the furnace. With small furnaces this may be well done by means of the granular carbon rheostat, the construction of which is described in detail. With large furnaces a rheostat is not a satisfactory apparatus for regulating the voltage, on account of the energy absorbed by it. There are two principal methods of regulating the voltage: First, an ordinary transformer is used to step down from the high-voltage line, and then beyond that is a regulator which acts as a variable flux transformer, boosting or lowering the voltage on the line going to the furnace; second, a transformer with a specially constructed primary which permits of varying the number of turns by a switching device, thus varying the voltage of the secondary. Examples of both methods, as used on a large scale in two plants in Niagara Falls, are described and illustrated. The author then discusses the construction of carbon electrodes, and compares especially electrodes of amorphous carbon and of graphite. Graphite electrodes can be often machined to great advantage and can be used with a current density two to three times higher than amorphous carbon, on account of the better conductivity of graphite. On the other hand, it is necessary to take care to prevent undue loss of heat in the case of graphite electrodes, on account of their higher heat conductivity. The author then describes several methods of electrode connections. The instructions given by the author for handling these problems are very full.—*Electrochem. and Met. Ind.*, January.

Zinc Coatings.—BURGESS.—A fully illustrated account of comparative tests of the properties of zinc coatings made electrolytically or by the hot-dip. The author has developed accurate tests for determining the durability of the zinc and the protection of the underlying metal against corroding influences; the adherence of the zinc coating; the roughness and malleability of the coating; the continuity and density and uniformity in thickness, and the resistance of the zinc to abrasion. The only point in which zinc coatings obtained by the hot-dip are superior to electrolytic coatings is when the material is to be heated and cooled at intervals; in this case electrolytic zinc has a tendency to blistering. On the other hand, electrolytic zinc coatings are decidedly superior with respect to other properties, especially in resistance to corrosion. For durability equal to zinc coatings made by the hot-dip, the electrolytic coatings should be deposited to an extent of about 12 grams per sq. ft., requiring about 10 amp.-hours for the deposition. To attain the advantage of great durability the electrolytic coat should be as thick as the hot galvanized deposit, or about 28 grams per sq. ft. This can be produced by 28 amp.-hours, or 14 amp. per sq. ft. for two hours. It is seen that to obtain the best quality of coating the disadvantages of the electrical method are brought out, the principal one of which is the great length of time required to apply the deposit. This can be remedied only by the use of high current densities, but with solutions at present available it seems impracticable to run the density beyond 18 or 20 amp. per sq. ft. on account of the liberation of hydrogen and undesirable physical quality of the deposit produced. In the tests made, 14.4 amp. per sq. ft. was taken as best representing practical conditions where a cold, unagitated solution is used. With this current density the metal may be deposited with a current efficiency of nearly 100 per cent. A serious limitation upon the electrolytic process as at present applied is that after the coating has reached a certain thickness there is a tendency for it to become rough and crystalline, and this tendency makes it extremely difficult to apply a coating having more zinc than 30 grams per sq. ft.—*Electrochem. and Met. Ind.*, January.

Zinc Metallurgy.—MEYER AND JOHNSON.—A review by Meyer of the present condition of the zinc industry, criticising new developments and proposals for the treatment of ores for roasting and smelting. The author mentions the electric furnace process of De Laval which is in actual operation in Sweden. The inventor subjects a mixture of preferably finely ground ore and of finely pulverized carbon, formed in a pile in a furnace chamber, to the action of radiant electric heat upon a sloping surface of the pile, and conducts away and condenses the metallic vapor generated at that surface. This process which is in operation in Sweden has the advantage that it is carried out in a simple apparatus, and that the electrodes probably have a long life as they come into contact with the metallic vapor only, and not with the charge directly. As, however, only the radiant heat is made use of, it can be worked advantageously only where cheap power is available. Hoepfner's process is in operation at the works of Brunner, Mond & Co., in England, for the manufacture of pure zinc which is guaranteed to be over 99.9 per cent. pure, and which is sold in competition to the Sterling zinc, made from the New Jersey Zinc Company's willemite in retorts. What kind of raw material, whether ores or scrap (hard zinc from the galvanizer?), Brunner, Mond & Co. use is not known. Some notes are given on the production of zinc dust and zinc white. The same number contains an article by Johnson on the metallurgy of sulphur compounds in the zinc retort.—*Electrochem. and Met. Ind.*, January.

REFERENCES.

Granular Carbon Resistance.—FITZ GERALD.—A communication on the properties of a new resistance material, called Kryptol, consisting mainly of grains of amorphous carbon and graphite. The author offers several criticisms of the patent of Voelker, but does not criticise the material itself, nor the importance of grading granular carbon carefully when used as a resistor.—*Electrochem. and Met. Ind.*, January.

Lead Refining.—WHITEHEAD.—An illustrated description of the Betts process of refining lead as operated at Trail, Canada, with a description of the melting house, the handling and refining of the slimes, and with analyses of the refined lead and of the slimes.—*Mines and Minerals*, January.

Hydrochloric Acid from Electrolytic Chlorine.—NAGEL.—An illustrated note in which the author suggests that in view of the low selling price of bleaching powder, electrolytic chlorine should be used for the manufacture of muriatic acid. Several experiments were made in Germany some time ago giving a satisfactory result, but at that time the manufacture of bleaching powder was more profitable. In the meantime the commercial conditions have completely changed. The author describes apparatus for the process.—*Electrochem. and Met. Ind.*, January.

Carbonate in Caustic Potash.—WINTELER.—An article on the contents of carbonate in electrolytic KOH solutions and in solid caustic potash. He points out the necessity of precautions which must be taken during the various steps of the manufacture to prevent the formation of carbonate.—*Electrochem. and Met. Ind.*, January.

Sewage Purification.—In an article on electrochemistry in Great Britain, some notes are given on the use of electrolytic hypochlorites for sewage purification. Experiments were made during the past summer at Guilford, but no figures as to the cost are available.—*Electrochem. and Met. Ind.*, January.

Technical Chemistry.—WALKER.—The first part of a paper on some problems in technical chemistry. He deals with the problem of fertilizers and discusses the fixation of atmospheric nitrogen by electric means and through the agency of bacteria.—*Electrochem. and Met. Ind.*, January.

Ozone.—KERSHAW.—An article on the production and utilization of ozone. The author describes a laboratory ozonizer of the Berthelot tube form, and the industrial ozonizers of Elworthy, Vosmaer-Lebret, Goldstein and Rosenberg. The author begins to make some remarks on European plants for utilizing ozone for water purification.—Lond. *Elec. Rev.*, December 30.

Electrolytic Dissociation Theory.—KAHLENBERG.—A very long abstract of a Faraday Society paper in which the author sums up a long series of objections to the theory. He emphasizes strongly the necessity of taking the affinity between solvent and solute into account. An abstract is also given of the discussion which followed.—*Electrochem. and Met. Ind.*, January.

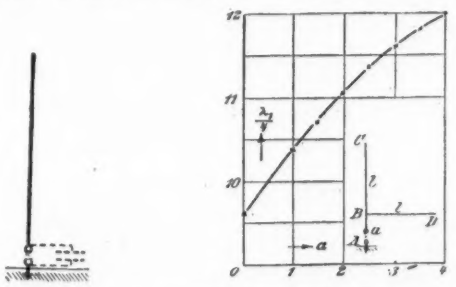
UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Small Differences of Phases.—SUMPNER.—An abstract of a British Physical Society paper. Hitherto, in order to measure the differences of phase between alternating-current quantities, it has

been necessary to use some method involving the simultaneous reading of three deflectional instruments, such as the wattmeter method, or the three-voltmeter method, either in its original or in some modified form. These methods cannot be successfully applied when the phase differences to be determined are small. The author describes new voltmeter methods which may be used for the purpose, and gives the results of a number of measurements on alternating-current plants. Difficulties arising in the measurement of very small alternating-current voltages are overcome by rectifying the voltages so as to utilize sensitive direct-current instruments. The paper gives the result of some tests on two transformers of 3 kw capacity intended to work between voltages of 100 and 1,000 and with currents of 100 cycles per second. One transformer was used to step up the volts from V_1 to V_2, the other to step down from V_2 to V_3. It was found that the phase difference between V_1 and V_3 for a non-inductive load increases regularly with the current. For an inductive load there is a sharply defined minimum at low power factor. The author suggested that points on one side of the minimum correspond to a lag, and points on the other side to a lead of the current on the voltage in the primary circuit. With respect to Sumpner's method of measuring small alternating voltages by rectifying them, although it might give good results when the wave form was known, Mr. Campbell thought that in the very cases where such measurements were wanted the wave form was not known. Small differences of power phase may be as much due to small differences in wave form as to small displacement of waves; thus the "difference" resultant is probably nearly always of very uncertain wave form. Drydale said he had given a good deal of attention to the measurement of small phase differences, and had found it advantageous to measure the sine of the phase difference instead of the cosine. This could be accomplished by putting a condenser in series with the pressure circuit of a wattmeter so as to produce a phase displacement of nearly 90°. In these circumstances he had previously shown that with ordinary conditions the watts were equal to the wattmeter reading plus a constant multiplied by the sine of the angle of phase difference. When, as was usually the case, the sine was nearly equal to unity, it was only necessary to add a constant to the wattmeter reading. In reply to Campbell, Sumpner said that, with regard to rectification, he was aware of the effect of the shape of the wave; he had made experiments with currents of very different wave forms, and in his opinion only about 20 per cent. of the observed results could be due to any alteration in the form of the wave. His methods were suggested as a means of getting an approximate value of very small phase differences which could not be determined in other ways.—Lond. *Elec.*, December 9.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—SLABY.—A further article in his serial on tuned wireless telegraphy systems. The most essential cause of the damping of oscillations is the resistance of the spark-gap. If, besides subdivision of the spark-gap in several partial spark-gaps, other means of decreasing the resistance are looked for, it is necessary to increase of the current, independent of the charge of the transmitter system. The means for this purpose is the superposition of a second current in the air-gap; this current is produced by additional capacities in such a way that it oscillates with equal frequency and in phase with the useful transmitter current. One simple arrangement for this purpose is shown in Fig. 2. The general principle is that



FIGS. 2 AND 3.—WIRELESS TELEGRAPHY.

any transmitter system can be "loaded" with capacity without change of the wave length, if the "load" is applied in a voltage node. Another interesting experiment is illustrated in Fig. 3, where a linear transmitter of bare copper wire, 0.8 mm. thick and 10 m. in length, was excited at A by a spark-gap, while the wire $BD = BC$ was coupled perpendicularly to it. The wave length of the system was measured while the positions of point B was varied. It was found that the transmitter was perfectly tuned to a single wave length, but the resulting wave decreased considerably with the length, $AB = a$, as shown in Fig. 3. The author develops a general theory to which he afterward adds some corrections.—*Elek. Zeit.*, December 20.

Magnetic Testing.—SEARLE.—A paper read before the British Institution of Electrical Engineers, on a series of very careful tests, especially with respect to the quantitative meaning of the effect of the "history" of the iron on its magnetic state. He introduces several terms, speaking of apparent, normal and virgin induction and permeability for the same magnetizing force. In practically all experiments he used a magnetic square, made up of iron or steel strips. His observation concerning the virgin state of steel is remarkable, showing that if a piece of iron that has not been acted upon by magnetic forces—at least not since its annealing—is tested and then demagnetized thoroughly, a great improvement in the magnetic quality is effected. Its normal permeability is much better than the apparent permeability before it had been demagnetized. In an editorial note on the paper it is said that "For the practical user of iron the result of all these is rather bewildering. * * * " The user of iron for transformers, and even for armatures will be ever more than inclined to the view that, after all, wattmeter tests tell him what he wants to know; and that hysteresis loops, however important from the physicist's standpoint, have but little use for him.—Lond. *Elec.*, December 9, 16, 23.

Electrolytic Wave Detector in the Bridge Method.—NERNST AND VON LERCH.—An article in which the authors make use in a new way of the electrolytic detector, employed in wireless telegraphy as a substitute for the coherer. They use the electrolytic detector as a zero instrument in a bridge combination on account of the ease with which it is constructed and the possibility of using a telephone. Two platinum electrodes polarized with two volts dip into a beaker filled with dilute sulphuric acid or potash. The anode is as small as possible, and consists of a platinum wire 0.02 mm. thick melted into a glass tube and cut off close to its end. If a rapidly oscillating current is superimposed upon this cell, a rise in the current through the polarizing circuit is noticed, and this can be easily observed by means of a telephone or galvanometer. The detector returns instantaneously to the zero, so that one hears a crack for every spark, and is, therefore, enabled to follow the interrupter in the telephone. The new detector is everywhere employed with advantage where it is a question of recording feeble but rapid oscillation, for is responds to gradually decreasing oscillations in a gradually decreasing manner. In this respect it differs markedly from the coherer, which either responds fully or not at all. The mode of action of the electrolytic coherer probably consists in a piercing of transition layers formed by polarization. The apparatus works with great regularity, but it is necessary to work quickly and read the temperature accurately as otherwise errors amounting to 2 per cent. may occur.—Lond. *Elec.*, December 30; from *Annalen der Physik*, No. 15.

The Electric Automobile Exhibit at the New York Show.

Standing in one of the balconies at the Garden on the opening night of the fifth annual national exhibition of automobiles in Madison Square Garden and looking down upon the densely packed crowd of people passing slowly up and down the aisles on the main floor, each intent upon examining the latest effort of American brains and ingenuity as illustrated by the exhibits, it was interesting to recall that other show held in the same place some seven or eight years before, at which a few pioneer horseless electric vehicles struggled bravely for recognition while hemmed in on all sides by a perfect "raft" of bicycles. In that early show a few horseless electric vehicles had to battle against an almost overwhelming number of bicycles for a fair share of public attention. In this year's show a small handful of electric automobiles are still struggling for a share of public attention, but now they are hemmed in on all sides by gasoline cars in place of bicycles. Steam is virtually out of it.

There were no gasoline cars in that early show, while in this year's show it might almost be said there are no other cars, for among the several hundred cars on exhibition, less than thirty are electrics, and even a smaller number yet fall under the head of steam. In fact, but six of the hundred exhibitors of cars show electric vehicles, and all but two of them exhibit gasoline cars as well—truly a striking condition of affairs when viewed from the standpoint of the electrical fraternity.

And yet some progress has been made in the electrical automobile field in the past year—not as much as one could wish to see, however—and it is only fair to those steadfast souls who, battling against great odds, have carried the electric vehicle industry a step farther on the road toward its ultimate success, to record it. Viewed as a whole, the electric automobile exhibit this year cannot be said to show any very striking advance—in fact, it is a question whether it is as good as some of the earlier efforts. The same diversity of opinion as to general design is still very noticeable, indicating very plainly that the development period has still a number of years to run. Apparently but little effort is being made by manufacturers of electric machines towards standardization. To say the least, there seems to be but faint excuse for the use of three styles of charging plug on as many makes of electric vehicles at this late day. It necessitated the keeping on hand of three styles of plug at garages, which is unnecessary, especially as there is a very good standard plug on the market, and one far superior to the styles of plug and receptacle used by at least two makers of electric machines.

Of the six companies exhibiting electric vehicles, the Vehicle Equipment Company has the largest number of cars on the floor. Its exhibit is confined entirely to electric cars and the greater part of those exhibited are commercial vehicles. This company has changed its product but slightly during the past year. In fact, the only change of importance that has been made has been the discarding of the double reduction gear used on heavy trucks between the motor and the wheel for the single reduction motor similar to those that have always been used on the light vehicles of this company. There are on exhibition a rear-boot Victoria, a hansom and two 2,000-pound delivery wagons of its well-known types, also one 3,000-pound delivery wagon, one two-ton truck, and three five-ton trucks of the company's standard design.

The next largest electrical exhibit is that of the Studebaker Automobile Company. This company in its space has a delivery wagon, a truck, a Victoria phaeton, a standard runabout, and a special high-speed stanhope, as well as several gasoline cars. The Victoria phaeton and the delivery wagon are new productions exhibited for the first time at this show. The phaeton is equipped with a motor to which a long counter-shaft is fastened. One end of this counter-shaft is fitted with a gear which meshes with the motor pinion; to the other end is attached the sprocket for the chain. The counter-shaft is held in place and runs in bearings fastened directly to the motor casing. This arrangement is said to reduce the wear on the gears, and consequently the machine is said to run a much longer time before adjustment is necessary and much more quietly than machines of this make have ever run before. This arrangement is an improvement on the last year style of counter-shaft transmission when the counter-shaft was only a few inches long.

The 1,000-pound delivery wagon is equipped with two 800-hp motors supported by the body and situated well back of the rear axle. In fact, the motors stick out beyond the line of the body, which leaves them exposed to the danger of injury through an accidental rear-end collision. There is chain drive from the motors to the rear wheels with a 5½ to 1 reduction. This necessitates a rather large sprocket on the rear wheels, but it does not look out of proportion. In fact, the wagon looks like a good serviceable vehicle with good strong steering-head and knuckles and should give a good account of itself in the service for which it was designed. The rest of the cars are not particularly new in design, and outside of the change in the position of the counter-shaft on all single motor cars there is nothing of special interest about them that has not already been pointed out in former years. They are all good, durable cars and will stand fairly severe usage on country roads, which is more than can be said for some of the other styles of electric automobiles on exhibition in the Garden.

The Electric Vehicle Company shows a few of its electric styles and a number of gasoline cars. Of the electrics the only new style is a Victoria phaeton with the motor suspended under, and atached to the body under the middle of the car. The lines of this car are very pleasing, and for light city use it should give good service. The finish of the cars of this company is very good. An electric landaulet, an extension front brougham, and a small runabout of standard design complete the electrical exhibit of this company. The brougham and landaulet are luxuriously finished both inside and out, and make very elegant private carriages.

The Baker Motor Vehicle Company has a very complete exhibit of its cars. It has an imperial, a stanhope, a surrey and a depot carriage in its stand. This is probably the most evenly balanced electric exhibit at the show. The Baker vehicles are so well known that they need no word of introduction. The changes since last year are not many. Wooden artillery wheels replace the wire wheels formerly used, and heavier axles and larger hubs are noticeable in the equipment of the surrey and depot carriage. These two have the motor in front under a bonnet and drive through a shaft and gears. The Baker car is a very nice little car for town and country use where roads are good, but it is much too lightly constructed for use over poor roads at any reasonable speed.

The Pope Motor Car Company shows a few electric cars among its gasoline cars. It has made no changes in its electric cars since last year. It still retains the extremely weak steering head and arm of former years, and there has been no attempt made to improve the lines of the bodies of its cars. The car is too light for use on heavy or poor country roads at any reasonable speed, and the steering head and arms do not look heavy enough to be safe. On the whole it cannot be said that the Waverly car has been improved any this year.

The National Motor Vehicle Company has but two electric cars on exhibition, and they are the same apparently in every particular as those of last year.

The Electric Storage Battery Company has a few sets of batteries on exhibition and a few exhibition boards to which individual plants and parts are fastened. Their only improvement this year outside of some minor mechanical changes in lugs and connectors is in the use of a new positive plate for heavy cells.

The Edison Storage Battery Company exhibits its now well-known cell in various sizes in a special exhibit in one of the upper balconies. Cells of the latest style are on view showing the new electrically-welded steel jars and the new method of supporting the cells in their trays. One of the new electric fillers is also on view, and those who were at St. Louis will remember and see again the historical exhibit shown there.

The General Electric Company has two charging sets in operation for use with alternating-current circuits using the mercury arc rectifier. These sets are now on the market and for loads up to 110 volts and 30 amp. are said to give very good satisfaction. The efficiency of a rectified charging set is said to be 80 per cent., as against 64 per cent. for a motor-generator set of the same capacity, and the cost is considerably less. It is gratifying to know that this very interesting piece of apparatus is now so far perfected that it can be put on the market, for it must certainly prove a most useful adjunct in electric automobile work. There is a three-phase generating plant in the basement, and this is "split" to supply two new panelboards devised for this class of work.

It is to be hoped that the coming year will see greater strides made in the development of the electric automobile than have been recorded for the past twelve months. Without question, the electric automobile is destined to supersede horse-drawn vehicles entirely on the busy streets of our large towns, but just how soon this much-hoped-for transformation will be accomplished, it remains for the future to disclose; and meantime splendid work is being done on the gasoline competitors.

In addition to the concerns mentioned above, a number of interesting exhibits were made of an electrical character, particularly in the field of ignition devices, many of which have already been described and illustrated in these pages. It was a noticeable feature that electric motors were in general use in the gasoline exhibits to "turn over" the automobiles shown, and the use of gasoline is strictly forbidden in the Garden. A notable exhibit in this group also was that of the Electro-Dynamic Company, Mr. G. H. Condict showing one of its new "Inter-Pole" motors in the exhibit of Hess-Bright ball bearings. This was the first public demonstration of the machine. Among other exhibits may be mentioned the fine big sign of the New York Edison Company, and it deserves mention that the Garden was all a-glitter with electric signs in every direction, probably the largest number ever shown under one roof being on view there. The effect was very striking.

Miscellaneous electrical exhibitors included the American Coil Company, Somerville, Mass.; American Electrical Novelty & Manufacturing Company, New York City; Atwater Kent Manufacturing Company, Philadelphia; Auto-Coil Company, Jersey City; Constant-Spark Plug Company, Boston; Crest Manufacturing Company, Dorchester, Mass.; Dayton Electrical Manufacturing Company, Dayton, Ohio; Dow Portable Electric Company, Braintree, Mass.;

Eastern Carbon Works, Jersey City; Electric Contract Company, New York City; Motsinger Device Manufacturing Company, Pendleton, Ind.; National Carbon Company, Cleveland, Ohio; New York Coil Company, New York City; William Roche, Standard dry batteries, New York City; Pittsfield Spark Coil Company, Pittsfield, Mass.; Polyphase Ignition System Company, New York City; Remy Electric Company, Anderson, Ind.; Rushmore Dynamo Works, Plainfield, N. J.; C. F. Splitdorf, New York City; Standard Welding Company, Cleveland, Ohio; United Electrical Manufacturing Company, New York City; Warner Instrument Company, Beloit, Wis.

New Single-Phase Integrating Wattmeter.

The newest development in Westinghouse integrating wattmeters is a new type known as "Type B," for use upon single-phase circuits of 60 and 133 cycles, and which embodies improvements in a number of features conducing to increased efficiency and long-lived calibration. It follows the Westinghouse standard designs, employing the principle of shunting the greater portion of the field due to the shunt winding, and allowing only a small portion of it to combine with the series field to produce a torque on the disc. By this means good load voltage and frequency curves are obtained. By a change in the design of the electromagnet the effect upon the disc is made double that of the type superseded, with the small shunt loss, the same accuracy upon light work and a minimum amount of variation in performance due to changes in voltage and frequency.

Figs. 1 and 2 show the wattmeter with glass and metal cover. It is compact in form and can be installed in a small space, the front connections on the top of the meter case adding materially to the convenience in installation. The fact that it is a sealed meter, with the original calibration preserved under the manufacturer's seal,

FIG. 1.—INTEGRATING WATTMETER WITH GLASS COVER.

and requires no adjustment when put into service also reduces the cost and the labor of installation. It is only necessary to fasten the meter securely to its supports by three screws, to connect the line wires to the four terminals and to take the initial reading of the meter—work which an intelligent lineman can do as well as a meter expert. It will be noted that the use of four binding posts and the connecting of both sides of the circuit to the motor, prevents its stoppage by removing a shunt lead without interruption to the circuit. The shunt connection is permanently made inside the meter.

All of the working parts are attached to a single casting, which gives strength and rigidity, and insures a perfect alignment and reduces the liability of injury from jarring. The moving element retains the lightness of that of previous types, with a greatly increased torque. The magnets are well aged, and mounted upon one bracket, which insures perfect alignment. The use of two magnets permits the adoption of a wider air-gap, thus eliminating the danger of the disc rubbing. Adjustments for changes in frequency, speed and friction are easily and rapidly made. At full load the disc makes twenty-five revolutions per minute.

The lower end of the shaft, upon which the rotating disc is

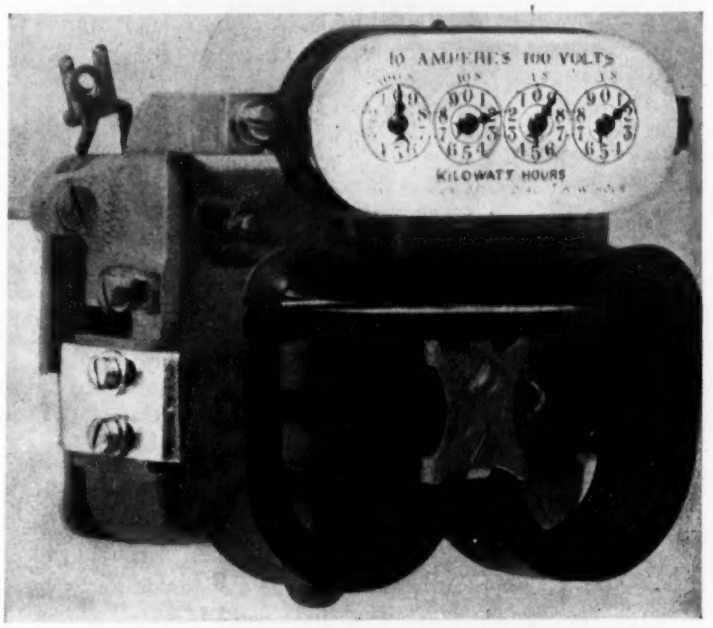


FIG. 2.—WATTMETER WITH COVER REMOVED.

mounted is fitted with a sapphire jewel slightly cupped. A corresponding jewel is placed in the end of the adjusting screw which forms the lower half of the bearing, and into the hollow space between the jewels a hardened steel ball is introduced. The polished steel surface of the ball is slightly less in radius than the jeweled cups, reducing the friction to an inappreciable amount, owing to the smallness of the points of contact.

The upper bearing presents some excellent novel features. The shaft which supports the disc is drilled out at its upper end slightly larger than the pin which is attached to the upper screw. The diameter is reduced at one point in its depth to form a bearing for the pin. At the bottom of the hole is placed a small piece of felt which is impregnated with oil. Capillary attraction causes the lubricant to creep upward oiling the bearing. Friction is thus reduced to a minimum, decreasing the wear and eliminating noise.

A four-dial counter is employed; its construction and the connection with the disc shaft being so perfect that no friction effects are perceptible. On meters of less than 3.84 kw capacity the first dial reads in the tenths of kilowatt-hour; in larger capacities the first dial records units. The meter records directly without the use of a constant. The accuracy is not affected by reasonable variation in voltage and it records correctly from two per cent. of full load to fifty per cent. overload, and under all conditions of power factor and wave form.

New Battery Switch for Automobiles.

A new battery switch is now being placed on the market by the Atwater Kent Manufacturing Works, Philadelphia. This switch is convenient and durable and is designed along the lines of larger electrical apparatus. The handle end of the lever is provided with notches to cause the lever to remain in any position it may be placed. The handle is substantial and can be manipulated easily when one's hand is covered by a heavy glove. The locking device has been omitted on this switch, as means for avoiding mischief are too well known now to make them effective, and the owner is often annoyed by himself mislaying the removable part.

Another convenient feature is that all the connections are made after the switch has been mounted on the dash and then the whole is

covered by a name plate. This avoids bending the wires after the connections are made, in order to screw the switch into place, and avoids also making a chance for a poor connection. If it is ever necessary to examine the connections, it may be done by simply

AUTOMOBILE BATTERY SWITCH.

removing the name plate. The switch is thoroughly designed and substantially made. All of the brass parts are made of heavy metal, and the only two holes that are tapped in the insulating part are bushed with brass.

Fort Wayne Electric Agents' Convention.

The Fort Wayne Electric Works is one of the oldest concerns in this country now engaged in the manufacture of electric lighting and power apparatus, and best known as the manufacturer of the "Wood" systems, in use in thousands of plants in this country. The original company from which the present concern has been developed was formed in Fort Wayne in 1881 to manufacture electric lighting apparatus and was called the Fort Wayne Electric Light Company. Its history has been marked by successive changes from the original Fort Wayne Electric Company in 1889, Fort Wayne Electric Corporation in 1894 and to the present name in 1899. The part this company has taken in the development of the electrical manufacturing industry of this country has been in no small way due to the ability of Mr. J. J. Wood, who is to-day recognized as one of the foremost inventors in the arc lighting field of this country, in which he was a pioneer in 1879. Modern demands on electrical engineers both in the lighting and in the power applications of electricity have been met and often anticipated by his genius and strong personality.

The Fort Wayne Company has just held a convention of its selling organization. The territory covered reaches from Boston to San Francisco and from St. Paul to Atlanta. The modern methods of a progressive business enterprise are well illustrated by the periodical conventions of the district managers of the various territories with the home office organization of this company. Beginning Tuesday morning, January 10, and closing Friday following, the daily business sessions of the sales forces were relieved by evening social functions of a very enjoyable nature. Representatives from Boston, New York, Philadelphia, Syracuse, Pittsburg, Atlanta, Cincinnati, Grand Rapids, Chicago, St. Paul and St. Louis discussed matters of common interest right on the ground of the central organization. The social features of the convention were distributed over the period covered by the sessions, several of the Fort Wayne hosts entertaining the visitors at their homes.

The closing feature of the convention was a banquet at the Anthony Wayne Club at which over 50 of the sales force were present. It was presided over by Judge R. S. Taylor, who has been counsel for the company ever since its infancy. Guests from the city included the local directors and others interested in local electrical organizations. Those from the district offices attending the banquet were as follows: J. Allan Smith, Boston, Mass.; J. C. Lott, New York, N. Y.; T. L. Sturgeon, Philadelphia, Pa.; C. A. Woolsey, Philadelphia, Pa.; E. H. Porter, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; F. S. Nicholson, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; G. B. Edgar, Cincinnati, Ohio; James O. Spear, Atlanta, Ga.; W. S. Goll, Chicago, Ill.; Frank McMaster, Chicago, Ill.; C. E. Sedgwick, Chicago, Ill.; W. C. Knight, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; A. L. Searles, Grand Rapids, Mich.

During the evening the district managers as an expression of their appreciation and esteem for the one who is responsible for the products they handle, presented Mr. J. J. Wood with a handsome loving cup through their spokesman, Mr. W. S. Goll, manager of the Chicago office. Mr. Wood has been with the Fort Wayne Company since 1890, when he went to Fort Wayne from Brooklyn, where he was manufacturing his arc dynamos and lamps when the Fort Wayne Company purchased the Brooklyn plant, and Mr. Wood transferred its machinery and men. He immediately assumed charge of designing new electrical apparatus and redesigning the old apparatus and electrical devices already in production by the company. The company advanced rapidly in the electrical manufacturing field, and "Wood" systems became more widely used than ever in electric lighting and power.

Spiral Guards for Incandescent Lamps.

A simple and ingenious guard for incandescent lamps has been made subject of a patent and brought out by S. H. Couch Co., Inc., of 169 Pearl Street, Boston. The thing is so obvious the engravings

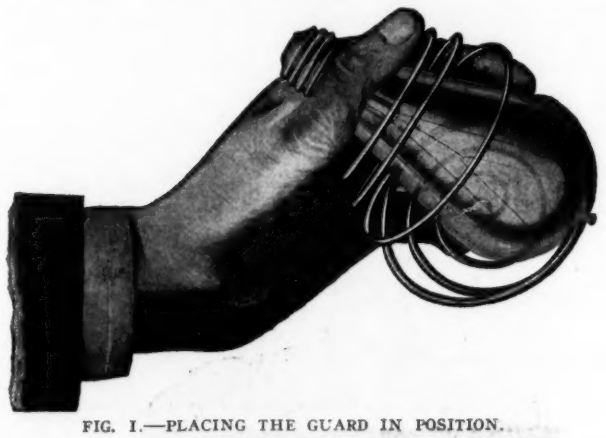


FIG. 1.—PLACING THE GUARD IN POSITION.

shown herewith hardly need any descriptive text to accompany them. Fig. 1 shows how the guard is put on. The lamp is inserted small end first between the largest convolutions of the wire, as illustrated,

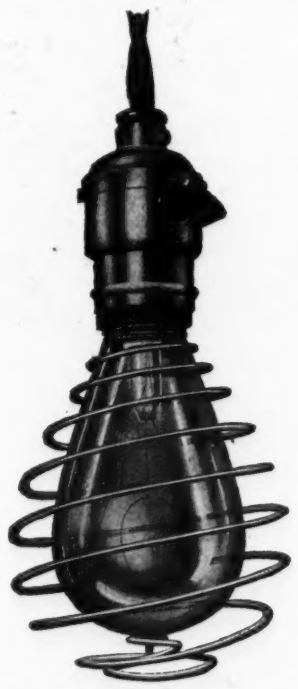


FIG. 2.—GUARD IN POSITION.

and the tip of the lamp is then seated in the nub or eye of the guard. Fig. 2 shows the guard in position on a lamp, making a neat, compact and sufficient protection for all ordinary purposes.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—While there are some irregularities in some sections, the general undertone is one of strength, with a feeling of confidence. The iron and steel industries and allied trades show marked activity. Midwinter quiet rules wholesale trade in most lines, and speculation in securities and staples is quiet to dull at generally steady prices. Generally speaking, manufacturing industry having three to four months' business booked ahead is running very full and displays more surface activity than does new business. The season for clearance sales in retail lines is well under way, and a large distribution is being stimulated by special prices and by seasonable weather conditions in most sections. A notably quiet trade at present is that of cotton goods, which feel the effect of recent price declines in the raw material in backward buying. Hardware manufacturers report three to four months' orders ahead; the shoe trade is looking up at the east, with buyers taking higher priced goods more freely; the woolen goods trade is in a strong position owing to the strength of the raw material, which is being bought heavily in Argentina and Australia for American account; the iron and steel trade is producing at close to the maximum; the coke situation has improved, and famine prices are no longer asked, while soft coal has been helped by cold weather and a better supply of cars. Railway earnings returns indicate a very full business proceeding through the country, and failures are about normal. Collections, as a whole, rank as fair to good, though the South still complains, and some extensions are asked for there. Iron and steel have been quiet as regards new business. Production, which ran about 16,500,000 tons for 1904, is now close to the 20,000,000-ton mark. New buying has not been large, but consumers take all deliveries as quick as offered. Premiums on steel billets are not as stiff as heretofore. The railroads are reported slow purchasers, yet the orders booked for the present year exceed 1,000,000 tons. Copper has eased up on expectations of enlarged production, brought about by the recent advance. The closing prices are: 15¼c. for Lake, 15⅛c. for electrolytic, and 14⅞c. for casting stock. The business failures for the week ending January 12, as reported by *Bradstreet's*, numbered 295, against 278 the week previous and 315 the corresponding week last year.

U. S. STEEL TROLLEY ROADS.—It is stated that the United States Steel Corporation will change the motive power on its two principal ore roads this year from steam to electricity, viz., the Duluth & Iron Range and the Duluth, Missabi & Northern. They are used for getting iron ore from the Mesaba range to the lake ports. The corporation will get its current from the new Great Northern Power Company. This power company has been working out for some time a great electric installation in the Duluth region. The $4,000,000 cash needed by the Great Northern Power Company has been secured through C. D. Barney & Co. and Tucker, Anthony & Co., of Boston. They have underwritten that amount, and the cash is available for the work of construction and installation. Current for the ore roads and later for the mines of the Steel Corporation in the Mesaba range is to be secured from the St. Louis River, near Duluth, Minn. It is claimed that there is available not less than 200,000 horse-power. For the initial installation the quantity will be about 30,000 horse-power.

MEXICAN WATER-POWER PROJECTS.—Concessions relating to three fair-sized Mexican water-power propositions are now being considered by the government authorities of the Southern republic. Mr. Julio Jaume is after the necessary permission to utilize upward of 3,000 liters of water per second from the River Tambaque, State of San Luis Potosi. It is proposed to use the power for general purposes. Mr. Pedro Diaz Barreiro is also seeking a franchise to utilize the waters of the River Atoyac, State of Puebla, to the extent of 1,500 liters per second. The energy will be largely used for lighting purposes. Another application has been sent in by Mr. Stuarte, who has proposed to use 1,500 liters of water every second from the Monte Alto and Los Tachos rivers, State of Mexico. The power will be used for lighting and in manufacturing plants in the vicinity.

ELECTRIC VOTING FOR PERUVIAN SENATE.—The Federal Electric Company, Washington Life Building, has recently secured a contract from the Peruvian Government for an electric voting machine to be used in the Peruvian Senate to record the votes of the National Senators in a visual system. The machine will be operated by means of a switch to be located at each senatorial desk, the Senators being thus able to record their votes on a large annunciator in such manner that their votes can be seen by themselves and the public, this system affording no question or difficulty as to the count. Red lights will denote the affirmative votes and green lights the negative one. There will be about 400 lights on the board.

LIGHTING EQUIPMENT FOR WASHINGTON.—The New Britain Machine Company, New York offices, 135 Broadway, Mr. George F. Tremain manager, has secured a contract for a complete direct-connected generating unit for installation as an addition to the lighting plant in the Evening Star Building, Washington, D. C. The company, which is the builder of the Case steam engine, has also taken a contract recently for no fewer than 130 engines of similar size and type for installation in the Copley, La., plant of the Atlas Portland Cement Company, 30 Broad Street, New York City. These engines will be utilized for driving conveyors.

MEXICAN POWER TRANSMISSION.—The Mexican Light & Power Company, Limited, 26 Broadway, in addition to generating power at its huge Necaxa hydro-electric plant for transmission to Mexico City and the El Oro mining district—a combined distance of some 150 miles—has decided to build transmission lines to the Temascaltepec, Zacualpam, Sultepec, Taxlo and Malmaltenango districts, Valley of Mexico. Mr. W. A. Ferguson, one of the chief electrical engineering experts of the company, is now engaged in making surveys for the new lines.

PLANT FOR CUBAN PLANTATION.—Mr. George F. Tremain, 135 Broadway, Eastern manager for the Chuse Engine & Manufacturing Company, Mattoon, Ill., has been awarded a contract for a complete lighting plant to be installed on a sugar plantation near Cardenas, Cuba. The generating unit will consist of a 13 in. by 13 in. Chuse engine, arranged for direct connection to a 50-kw. generator, with switchboard instruments, lamps, wiring, etc.

FIVE THOUSAND-HP PLANT FOR CHICAGO.—Sears, Roebuck & Co., of Chicago, Ill., have placed a contract with the Thompson-Starrett Company, of 49 Wall Street, New York City, for the construction of a huge building, which will be installed with a power plant of 5,000 hp capacity. Adams & Schwab have been retained as consulting engineers.

PLANT FOR HOSPITAL.—The plant to be put in the hospital to be built on Third Avenue, between Sixty-third and Sixty-fourth Street, by the Manhattan Eye, Ear and Throat Hospital, will consist of one 100-kw. and a 75-kw. generator, arranged for direct connection to centre crank engines. York & Sawyer, of 156 Fifth Avenue, are the architects.

G. E. EQUIPMENT FOR BIG IDAHO PLANT.—The Washington Water Power Company has placed a contract with the General Electric Company for the initial electrical equipment to be installed in its big power plant at Post Falls, Idaho. The immediate equipment will have a capacity of 9,000 hp, while the ultimate development of the plant will be 18,000 hp.

LIGHTING EQUIPMENT FOR GUAYAQUIL.—An extensive electric lighting system is to be installed at Guayaquil, the principal city in Eucador, located on the seaboard. The Elmer P. Morris Company, of 15 Cortlandt Street, has secured an order for various material, etc.

LIGHTING FOR SANTIAGO.—A lighting plant is to be installed at Santiago de Cuba. The initial capacity will be about 500 hp. The General Electric Company has secured the contract for the generators—two machines—each arranged for direct connection to Buckeye engines.

LIGHTING PLANT FOR PASSAIC.—The lighting plant to be installed at Passaic, N. J., the contract for which has been secured by the Weehawken Construction Company, will be of about 1,200 hp capacity. Two hundred 2,000-cp. arc lamps will be contracted for.

LIGHTING FOR MANILA HARBOR.—A fair-sized electric lighting outfit has been ordered from Mr. George F. Tremain, 135 Broadway, for shipment to the Philippine Islands, where it will be used in connection with the harbor improvement work at Manila.

LIGHTING PLANT FOR ASYLUM.—An isolated electric lighting plant will be installed in the asylum to be built at Kingsbridge by the Hebrew Infant Asylum. The engineer has not been chosen yet. A gas engine will, in all probability, be used to drive the dynamo.

PLANT FOR FLUSHING SCHOOL.—Mr. A. Daicourt, 291 Sanford Avenue, Flushing, L. I., has been the successful bidder for the electric equipment to go in Public School No. 22, Flushing.

SWITCHBOARD CONTRACT.—The switchboard equipment of the fine new building at 60 Wall Street, New York, is being made by the H. Krantz Manufacturing Company, Brooklyn.

G. I.-STANLEY CONSOLIDATION.—The consolidation is announced of the Stanley Electric and General Incandescent Arc Light Companies, of Pittsfield, Mass., both of which are controlled by the General Electric Company. The new corporation is to be known as the Stanley-G. I. Electric Manufacturing Company, and will take over the manufacture and sales of the products of the two concerns, doing all the work in the local shops. It is probable that Senator Crane will remain president of the new company, and the vice-presidents will be: First, C. C. Chesney; second, M. D. Barr; third, M. J. Insull. R. S. Murray will be treasurer of the consolidated company. At present he is assistant treasurer of the Stanley Company. The consolidation will go into effect February 1. There will be practically no changes in the engineering and manufacturing departments of the Stanley plant, though some changes are contemplated in the sales department. The capital will remain at the same figure at which the Stanley is now incorporated. Mr. Barr, the new second vice-president, will be located in Pittsfield. Mr. Insull will make his headquarters in Chicago, and will supervise the sales in the Middle West, where he is well and widely known. A large increase in the general business of the company is expected in all departments.

DATA AS TO LONDON ROADS.—Mr. H. Clay Evans, U. S. Consul General, London, furnishes the following summary of data: There are in London about 115½ miles of tramways, of which 88 miles have been purchased by the London County Council under the provisions of the tramway act, 1870, the remainder, about 27½ miles, are still in the hands of various tramway companies, nine in number. The tramways owned by the council comprise on the north side of the Thames River the undertakings of the North Metropolitan and the London Street Tramways companies, a total length of 48 miles, and on the south side of the Thames the undertakings of the London, the Southeastern Metropolitan, and the South London Tramways companies, a total length of about 40 miles. The tramways owned by the council on the north side of the Thames (48 miles) are leased to the North Metropolitan Tramways Company for a period of fourteen years, expiring in 1910; those on the south side of the Thames (40 miles) are operated by the council itself. The tramways act of 1870 provides that the local authority concerned may purchase compulsorily, after a period of twenty-one years from the date of the authorization by Parliament, any tramways constructed and operated by private companies.

DUTY ON CEDAR POLES.—In a decision written by General Appraiser McClelland, the Board of United States General Appraisers in New York City this week overruled, without affirming the correctness of the Collector's classification, a protest by the Perfection Pile Preserving Company, of Port Townsend, Washington, against the classification as telegraph poles at 20 per cent. of 710 cedar logs, containing 27,400 feet of lumber. Free entry was claimed for them as rough-hewn timber, and the importers testified that they were nearly all used for piling. Mr. McClelland rules that they are properly dutiable at 1 cent a cubic foot as hewn timber, but as this claim is not made, he does not disturb the Collector's classification.

WHITE RIVER POWER, MICH.—A company of Grand Rapids, Mich., citizens has been formed to develop the power of the White River, and the rising firm of Bates & Neilson, consulting electrical engineers, of New York, is associated with the scheme. The organization comprises M. B. Wheeler, A. O. Wheeler, R. H. Updyke and Wesley W. Hyde. Two dams are to be constructed, the first some seven miles above Whitehall with a minimum of 4,000 hp and another further upstream to develop 3,000 hp. Work begins this spring, and $1,000,000 will be spent. Grand Rapids is the ultimate point of delivery, but Muskegon, Whitehall, Fremont and Montague are all within easy striking distance. The company will be capitalized at $1,500,000.

BISHOP GUTTA PERCHA MEETING.—At a meeting of the stockholders of the Bishop Gutta Percha Company held January 11, the following named gentlemen were elected directors for the ensuing year: Amos A. Browning, Norwich, Conn.; Ellen I. Anderson, Rochester, N. Y.; Henry A. Reed, Newark, N. J.; Harry D. Reed, New York City; W. Boardman Reed, Mount Vernon, N. Y.; and the usual semi-annual dividend of 5 per cent. on capital stock was declared. The directors elected for president and treasurer Henry A. Reed; for vice-president, W. Boardman Reed; and for secretary, Louis F. Reed.

RAILROAD TELEPHONES.—The Hocking Valley, Toledo & Ohio Central and other allied lines have practically closed a contract with the Bell Telephone Company for the establishment of an extensive private telephone system to connect all of the local offices and by composite use of the telegraph wires of the companies to furnish long distance service for Toledo, the docks, Walbridge, Upper Sandusky, Marion, Delaware, Lancaster, Logan, Athens and Nelsonville. There will be about 45 telephones in all. The system will be in operation early in January. Trains will not be operated by this plan.

PROMETHEUS ELECTRIC COMPANY.—The annual meeting of the Prometheus Electric Company, manufacturers of electric heating apparatus, was held in the city of New York on Monday, January 9, at which the following officers were elected: President, D. T. Davis; vice-president, Dr. S. S. Wheeler; secretary, Max Loewenthal; treasurer, William B. Symmes, Jr.; and the following directors to serve for one year: David T. Davis, Dr. S. S. Wheeler, William B. Symmes, Jr., F. S. Blackall, Max Loewenthal.

POWER IN ARIZONA.—The United Gold and Platinum Company, which has claims on the rim of Cataract Canyon, in the Grand Canyon neighborhood, has located for power purposes the falls of Cataract Creek, and proposes to secure from them electricity for furnishing power for a railway line into the canyon, from a connection with the Grand Canyon line of the Santa Fe Company. H. J. Beemer, of New York, is interested in the enterprise.

DETROIT TROLLEY IMPROVEMENTS.—The Detroit United Railway is enlarging its power house to accommodate an additional 2,000-hp unit with engines, boilers, generators and distributing apparatus. The company has contracted for 50 new double truck cars, 25 of which will be built by the Brill Company and the remainder by the St. Louis Car Company. The total outlay involved is $400,000.

TELEPHONES FOR GUAYAQUIL.—The Monnett Telephone Company, of Chicago, Ill., has just closed an order for 200 telephones and a large quantity of construction material and necessary apparatus to be shipped to Guayaquil, Ecuador. The company which will be established at Guayaquil has succeeded in building up a very good business.

ATLANTIC CITY CONDUIT.—In his fifth annual report, City Electrician A. C. Farrand, of Atlantic City, N. J., has recommended that the council lay down a municipal conduit system on Atlantic Avenue before that street is paved. He recommends also the undergrounding of other wires where conduits already exist.

PLANT FOR WAUKEGAN, ILL.—A large light and power station is to be built at Waukegan, Ill., by the North Shore Electric Company, of Chicago, which concern supplies light and power to cities and villages located between Chicago and Milwaukee. Sargent & Lundy, the Chicago electrical consulting experts, are now preparing the plans.

TURBINES IN MONTREAL CAR WORKS.—The Canadian General Electric Company has secured a contract to install a turbine power plant at the works of the Canada Car Company, of Montreal. This new plant will be the first of the kind to be erected in Canada.

TWELVE THOUSAND-HP HYDRO-ELECTRIC PROJECT.—The Berrien Springs (Mich.) Power & Electric Company is maturing plans for the construction of a hydro-electric plant at Berrien Springs, which will have a capacity of 12,000 hp.

TELEPHONE SUPPLIES.—Police Commissioner McAdoo, of New York City, will receive bids until January 25 for telegraph and telephone supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was narrow with temporary bullish fluctuations, due to the uncertainty as to railroad rate legislation at Washington, although easy money and the scarcity of investment issues exerted a sustaining effect. The market was rather barren of actual developments. The announcement of the Pennsylvania Railroad's proposed $50,000,000 bond issue was not, on the whole, favorably received on "the Street." The strength of Manhattan and a remarkable rise in Interborough stock on the curb to 192, with rumors of a merger of the companies, gave support to all the traction stocks, and made them, in a measure, a sustaining factor in the market. The United States Steel stocks received some effective support at around 29 for the common and 92 for the preferred. Electric stocks were quiet but firm, General Electric closing at 188⅛, a net gain of 1⅛ points, and Westinghouse closed at 180, a gain of 1 point, and Allis-Chalmers, common and preferred, at 16½ and 65, respectively, these figures representing a gain of ½ point in the former class and a loss of ¾ in the latter. The traction securities, as already noted, showed much activity. Interborough Rapid Transit (a curb stock) made a net gain of 20¼ points, closing at 190½, after having reached 193. The lowest quotation of this stock during the week was 168¼. Manhattan Elevated made a net gain of 4 points, closing at 170½. Metropolitan Street Railway was quite actively dealt in at prices ranging from 114⅛ and 117¾, closing at 117¼, a net gain of 1¾. Brooklyn Rapid Transit closed at 62⅛, being a net advance of 2⅜ points. Western

Union was off a fraction, closing at 92⅞, and American Telephone & Telegraph closed at 146¾. Except for the advance of Interborough, the outside market was featureless. Following are the closing quotations of January 17:

NEW YORK

	Jan. 10	Jan. 17		Jan. 10	Jan. 17
Allis-Chalmers Co.	16	15⅜	Electric Vehicle	11	15
Allis-Chalmers Co. pfd.	64	64	Electric Vehicle pfd.	20	23
American Tel. & Cable.	93½	93½	General Electric.	186¼	188½
American Tel. & Tel.	146⅜	145½	Hudson River Tel.	..	..
American Dist. Tel	38	..	Interborough Rap. Tran.	180¼	187
Brooklyn Rapid Transit.	60¼	63¾	Metropolitan St. Ry.	115¾	116¾
Commercial Cable.	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	40	41	Marconi Tel.	..	..
Electric Boat pfd.	80	78	Western Union Tel.	92⅛	92
Electric Lead Reduction.	⅛	⅛	Westinghouse com	179	182
			Westinghouse pfd	187	192½

BOSTON

	Jan. 10	Jan. 17		Jan. 10	Jan. 17
American Tel. & Tel.	148	145	Western Tel. & Tel. pfd.	*99½	99½
Cumberland Telephone.	121	120	Mexican Telephone.	1⅜	1¾
Edison Elec. Illum.	251	251½	New England Telephone.	138½	139⅜
General Electric	185	188½	Mass. Elec. Ry.	13½	13⅝
Western Tel. & Tel.	*19½	18	Mass. Elec Ry. pfd.	58½	59½

PHILADELPHIA

	Jan. 10	Jan. 17		Jan. 10	Jan. 17
American Railways	47½	48	Phila. Traction.	90½	90⅞
Elec. Storage Battery.	75	77	Phila. Electric.	9¾	10
Elec. Storage Battery pfd.	75	77	Phila. Rapid Trans.	17¾	18⅛
Elec. Co. of America.	11⅛	11⅜			

CHICAGO

	Jan. 10	Jan. 17		Jan. 10	Jan. 17
Central Union Tel.	..	..	National Carbon pfd.	110	..
Chicago Edison.	..	169¾	Metropolitan Elev. com.	22	20½
Chicago City Ry.	192	193	Union Traction.	11⅜	11
Chicago Tel. Co.	143	..	Union Traction pfd.	45	45
National Carbon.	41⅛	41⅜			

* Asked.

INTERBOROUGH EARNINGS from the new subway are increasing rapidly, and this week will see New Yorkers able to use the underground from as far downtown as Fulton Street and Broadway. Subway traffic has undoubtedly reached larger volume than many people expected it to achieve so soon. The elevated also, on which the Interborough guarantees a 7 per cent. dividend, has apparently lost less than was expected. With $1,825,000 surplus earned over the 7 per cent. dividend last year, the elevated could apparently lose 40,000,000 from its yearly passengers, or 109,000 a day, and still earn the dividend required. The subway company's statement of November 26 showed 5,838,235 passengers carried in the first 29 days of business, bringing in an average of $10,065 per day. This average would mean $3,650,000 per year. But the estimate of the company's bankers, given out in January, 19003, was that $7,500,000 would eventually be earned per annum, which, with operating expenses at 45 per cent., would leave a trifle over 8 per cent. over and above the $1,400,000 annual interest due to the city. The November average would earn less than half of that. It will be very interesting to see how soon the figure of the estimates is reached. Rumors are afloat of a proposed purchase of the Interborough at $200 a share, or more.

TROLLEYS IN NEW YORK STATE.—The New York State Railroad Commission has just presented its report for 1904. Regarding street surface railroads, the board reports the cost of their road and equipment up to the year at $470,668,920, a gain of $16,000,000 over 1903. Net earnings from operation were $20,567,122 in 1904 and $20,715,127 in 1903. These roads still have in their equipment 4,443 horses, but the number shows a decrease of over 600 since 1903. The report contains the following comparisons:

	1903.	1904.
No. of passengers carried, including transfers	1,267,563,057	1,341,766,931
Number of transfers	305,548,230	312,860,257
Tons of freight carried	514,460	633,674
Passenger car mileage	192,583,182	199,767,097
Freight and express car mileage	724,950	1,097,498
Mail car mileage	214,698	219,790

During the year 193 persons were killed on street surface roads and 878 injured.

NEW ORLEANS CONSOLIDATION.—Attorney General Guion, of Louisiana, has announced that he cannot assent to the proposed reorganization plan for the New Orleans Railway Company, as he considers that the stockholders would be compelled to bear too great a proportion of the burden. Mr. Guion says: "I had not been informed that the floating debt exceeded $2,600,000. It seems to me not absolutely necessary that this debt should be paid, but the creditors to whom it is due should be made to understand that it is impossible to settle with them except out of future earnings of the reorganized corporation. I do not appreciate the absolute necessity of purchasing the stock of the gas company, but it seems to me that if the bondholders insist upon the purchase the money should be contributed by those persons who undertook, along with the New York Security and Trust Company, to underwrite the scheme."

KEYSTONE TELEPHONE, PHILADELPHIA.—A number of minority stockholders in the Keystone Telephone Company have come out openly charging the management with defrauding them in connection with deals over the purchase and sale of street conduits. The report presented at the annual meeting showed the company to be in a flourishing condition. Total gross earnings for the year ending December 31, were $685,740, an increase of $204,516. The total net earnings were $352,437, an increase of $119,922. The company has 16,000 telephones in operation, and its physical condition is such that no large expenditures are expected this year. President Mack made no reference to the conduit deal said to be on foot with the Commonwealth Electric Company.

MICHIGAN STATE TELEPHONE.—Directors of the Michigan State Telephone Company have declared the usual quarterly dividend of 1½ per cent. on the preferred stock. N. W. Harris, chairman of the board of directors, says: "The company has expended over $600,000 in maintenance of plants in various parts of the State, in addition to full operating expenses, and has also expended for new construction and betterments over $1,000,000 in order to meet the growing demands of business. This is a larger sum than we anticipated expending, but the company desires to give the very best service possible, going to all reasonable lengths to do so. I consider that the State is in a highly prosperous condition. The growth of the telephone business has been remarkable."

BID FOR CHICAGO CITY RAILWAY.—On behalf of J. P Morgan & Co., managers of the syndicate which will finance the purchase, Marshall Field, John J. Mitchell and P. A. Valentine have made a public offer to holders of Chicago City Railway stock to buy this stock at $200 a share, providing 80,001 shares are secured under the terms of the offer. The stock is to be delivered to the Illinois Trust and Savings Bank in Chicago before February 15, and depositors will receive payment in cash on or before March 31 if a majority is delivered within the time specified. It is expected that the required amount of City Railway stock will be secured and that this property will be merged with the present Chicago Union system.

PHILADELPHIA RAPID TRANSIT.—The estimates in Philadelphia are that Philadelphia Rapid Transit will be earning gross from $20,000,000 to $22,000,000 per annum by the time the Union Traction guaranteed dividend shall have reached its maximum of 6 per cent., or $1,800,000 on Union Traction stock, in 1909. The gross earnings have increased $4,000,000 in the last five years, and at the same rate of increase they would be at least $20,000,000 in the year in question, having been $16,096,363 in 1904.

DIVIDENDS.—United Traction, of Albany, directors have declared the regular dividend of 1¼ per cent. Consolidated Car Heating Company's directors have declared a semi-annual dividend of 1½ per cent. American Graphophone directors have declared the regular quarterly dividend of 1¾ per cent., payable February 15. Directors of the Edison Electric Illuminating Company have declared a regular quarterly dividend of 2½ per cent., payable February 1. Michigan State Telephone has declared the regular quarterly dividend of 1½ per cent.

THE WHITNEY ELECTRICAL COMPANY, of Chicago, which is capitalized at $56,000,000, has been placed in the hands of a receiver, whose bond was fixed at $500. One of the inventions the company was formed to promote, consisted in "Ejecting or shooting above and beyond the atmosphere of the planet commonly known as the earth, four brass balls, which are supposed to gently and peaceably remain beyond said atmosphere after once having been shot or thrown up there."

AMERICAN GRAPHOPHONE COMPANY shows a total net income for the year ending September 30, 1904, of $729,925, charges of $126,467, and surplus of $603,458. After paying preferred and common dividends, the surplus was $487,078, of which $280,000 was carried to reserve account, and $207,078. This compares very favorably with the two preceding years.

PHILADELPHIA RAPID TRANSIT.—Mr. P. A. B. Widener admits the truth of the report that the Philadelphia Rapid Transit Company will issue $10,000,000 4 per cent. bonds to be secured by a mortgage on the subway and elevated now being constructed on Market Street.

PLANT WANTED.—W. A. Miller, of W. W. Miller & Sons, grain dealers, Anthony, Kan., has been appointed a committee to put in an electric light plant for the city, and he will be glad to hear from parties desirous of furnishing the equipment.

GREAT NORTHERN POWER COMPANY.—The Great Northern Power Company, of Duluth, has filed articles raising its capital stock to $2,000,000 and increasing the limit of liability to $10,000,000.

TOLEDO RAILWAYS AND LIGHT.—The Toledo Railways and Light Company shows for 1904 gross of $1,752,833 and net of $829,625, leaving after all charges a surplus of $329,751.

NORTHERN OHIO TRACTION shows a gross for 1904 of $895,731, net of $408,751, and surplus, after all charges, of $135,087.

General News of the Week

The Telephone.

FULLERTON, CAL.—The Sunset Telephone Company is arranging to rebuild its lines in Fullerton.

HOPEDALE, ILL.—The Farmers' Telephone Company, of this city, has increased its capital stock from $5000 to $20,000.

DEER GROVE, ILL.—Messrs. Ed Devine and Frank Renner have organized the Hahnaman Mutual Telephone Company.

CHICAGO, ILL.—The Chicago Telephone Company will erect a new brick office building at 794 North Western Ave., to cost $25,000.

TOWER HILL, ILL.—The South Tower Hill Mutual Telephone Company has been incorporated by J. W. Jones, S. S. Herton and others.

METAMORA, ILL.—The Metamora Telephone Company has purchased the interest that the Central Union controlled here, and will enlarge its system.

LENA, ILL.—The Howardville Telephone Company has been incorporated with a capital of $2500. The incorporators are W. Fisher, G. W. Davis and others.

PETERSBURG, ILL.—The Petersburg Telephone Company has been formed, capital $20,000. Incorporators: John S. Hurle, R. A. Kelly and Richard Waldridge.

ALTON, ILL.—The Kinloch Telephone Company has planned a series of improvements involving an outlay of over $40,000. The system in Middletown will also be improved.

ALEXIS, ILL.—The Farmers' Mutual Exchange Telephone Company has been incorporated with a capital stock of $5000. The incorporators are A. Moore, W. Brewington and others.

CHICAGO, ILL.—The Royal Trust Company, of Chicago, and H. E. Ambler, trustees, have begun suit at Sioux Falls, S. D., for the appointment of a receiver for the Citizens' Telephone Company of that city, and possession of the property under foreclosure proceedings, it being alleged that the company has defaulted in the payment of interest on its bonds.

BLOOMINGTON, ILL.—The Home Telephone Company has completed two new trunk lines between its Normal and Bloomington exchanges, which will assist in handling the business between these two places. The two switchboards at the Normal exchange have also been equipped entirely with new drops, making practically new boards of them and insuring much better service.

HILLSBORO, ILL.—The People's Mutual Telephone Company has raised its rates slightly in order to meet current expenses. The present board of directors are A. G. Butler, Fillmore, president; R. P. Barnard, Nokomis, secretary and manager; George Taylor, Litchfield; A. K. Vandever, Irving; Charles Poland, Fillmore; W. Potts, Honey Bend; George Rainey, Hillsboro, and H. H. Zimmerman, Harvel.

AURORA, IND.—The Farmers' Co-operative Telephone Association, of this city, has been formed. Capital stock, $1000.

LEBANON, IND.—Lebanon has granted two franchise to the Bell and Lebanon Telephone companies, putting both on an equal footing.

RUSHVILLE, IND.—The Spineland Co-operative Telephone Company is seeking a franchise in this city, to compete with the local company.

NEW ALBANY, IND.—The independent telephone line between Ramsey and Fredericksburg will be connected with the Cumberland Telephone system.

RAMSEY, IND.—The Fredericksburg & Ramsey Telephone Company has been organized. F. L. Crayden, of Hancock, was elected president, Ed. McKinster, secretary, and G. R. Durnil, treasurer.

CHARLESTOWN, IND.—A number of farmers residing between Sellersburg and Charlestown will ask the board of commissioners at the January term for a franchise, and a home company will establish a line between the two towns.

FORT WAYNE, IND.—The stockholders of the Pierceton Telephone Company have decided to build a new copper circuit from Larwill to Warsaw. The home company will co-operate with the Fort Wayne, Columbia City, Warsaw, Plymouth and South Bend Independent companies and build a copper trunk line from the first named city to Chicago.

WICKLIFFE, IND.—The Crawford County Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $2000. The company proposes to construct and operate telephone lines and exchanges in Crawford and Orange counties. The principal exchange will be in Wickliffe. J. T. Zimmerman is president, and G. W. Flick, secretary.

INDIANAPOLIS, IND.—The Board of County Commissioners has renewed its contract with the Indianapolis Telephone Company for county telephonic service. The cost for telephones last year was $1140; for 1905 it will be $800, with several telephones added to the Cumberland line. These will be located in the offices of Coroner, Recorder, Surveyor, Board of Children's Guardians' Home, Irvington, and the Marion County Workhouse.

FORT WAYNE, IND.—A rural telephone combination that is attracting much attention among investors in this part of the State has just been effected in Whitley and adjoining counties. The officials of the Whitley company, which covers the entire county, have entered into a contract with the officials of the Wilmot Mutual Telephone Company, with exchanges and 300 subscribers at Wilmot, North Webster and Cromwell, whereby the subscribers of both companies will have the right of free service with the exchanges at Etna, and vice versa. The Wilmot subscribers will have free communication with the exchanges at Columbia City and Larwill. The companies agree to build trunk lines to accommodate the new service. The Whitley company has also closed a free communication contract with the company operating at South Whitley, Luther and Bippus.

TULSA, I. T.—The Pioneer Telephone & Telegraph Company has announced that it will install a new telephone system in Tulsa with switchboard capacity of 2200 telephones. It will be an exact duplicate of the system in Muskogee and will cost, complete, in the neighborhood of $50,000. Nine new toll lines will be built in Indian Territory by the company in the next six months.

MILLFORD, IA.—The Midland Telephone Company has been granted a franchise.

SPIRIT LAKE, IA.—This city has granted a franchise to the Midland Telephone Company.

TALMAGE, IA.—The Farmers' County line has been built, with centrals at Thayer and Talmage.

SOLON, IA.—Plans have been arranged for another telephone line here. Will Cambridge is the promoter.

DUNKERTON, IA.—The Blakeville Mutual Telephone Company has been organized with a capital of $50,000.

DUBUQUE, IA.—A movement has been started to build a telephone line between East Dubuque and Kieler. A. Kaiser and Frank Balsing are the promoters.

CLINTON, IA.—The Tri-City Telephone Company has been incorporated with a capital stock of $60,000. The company has exchanges at this city and Lyons. A. G. Hawley is president.

WELTON, IA.—The Welton Mutual Telephone Company has held the annual meeting and the following officers were elected: President, Herbie Buck; vice-president, Andrew Gregoire; secretary, Lewis Loofboro, and treasurer, M. C. Mudge

APLINGTON, IA.—Arrangements have been made between the Aplington telephone exchange and the New Hartford exchange to make connections which give the patrons of the Aplington connection with New Hartford, Stout, Finchford, Dike, Janesville and Swanton for a fee of ten cents.

DES MOINES, IA.—In a decree signed by Judge Howe, the Iowa Telephone Company secured a judgment against State Treasurer John Herriott in the amount of $5928. The company paid this sum to the State in taxes, under a law which the Supreme Court has since held to be unconstitutional, in a similar suit. The judgment is directed against Martin, Gilbertson and about 35 other citizens of the State, who were on Herriott's bond as State Treasurer.

LARNED, KAN.—The Ash Valley Telephone Company has been formed with $2000 capital.

STOCKTON, KAN.—The Stockton & Sugar Leaf Telephone Company has been incorporated, capital $2000.

BROOKVILLE, KAN.—The Brookville Telephone Company, of this city, has been formed. Capital $5000.

DODGE CITY, KAN.—The Dodge City Telephone Company is extending its lines to Ford City and thence to Bucklin and Rock Island.

FT. SCOTT, KAN.—There is a growing demand that some arrangements be made with the telephone exchange to connect with all of the rural telephones in this and Crawford Counties. Lines are being constructed in the southern part of Bourbon County and also in Crawford County with 17 running into McCune alone. The Greenbush-Walnut telephone line has been brought into Walnut and connected with central of the Walnut system. This line extends from Walnut to Greenbush and McCune with exchange privileges on the St. Paul line.

LOUISVILLE, KY.—The Home Telephone Company of Louisville is reported to have secured an option on the People's Independent Telephone Company, of Paducah, Ky. It is also stated that the Home Company will enter the Paducah section of the State.

BALTIMORE, MD.—A committee appointed by the general manager of the Baltimore & Ohio Railroad has recommended a system of telephone lines for moving trains. The telephone are to supplement rather than displace the telegraph system.

FALL RIVER, MASS.—A controlling interest in the Fall River Automatic Telephone Company has been secured by a syndicate headed by J. T. Swift.

MIDDLEBORO, MASS.—The selectmen have granted a petition of the Southern Massachusetts Telephone Company for the privilege of pole rights in the highways leading to Wappanucket, to string wires for the proposed extension of the "farmers' telephone" line from this town to Lakeville. The Lakeville board has granted a similar franchise in that town.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has won its fight against the City of Ypsilanti, Judge Kinne having dismissed the injunction restraining the company from tearing up the city pavement.

CADILLAC, MICH.—At a recent meeting of the business men of Cadillac, it was unanimously decided to use the service of the Citizens' Telephone Company. The service at Cadillac is being much improved and a new toll line from Cadillac to Harrietta has been completed.

WILLIAMSVILLE, MICH.—Diethrich & Kantz have started a telephone line to connect the rural districts near Williamsville with Union, Elkhart and some of the larger cities. The Birch Lake Telephone Company is building a number of lines to connect with Jones, Constantine, Mottville and some of the smaller towns.

MILNOR, MINN.—The telephone exchange in this city was recently destroyed by fire.

WILMONT, MINN.—The Farmers' Mutual Telephone Company will install an exchange in this city.

LISMORE, MINN.—The Lismore Mutual Telephone Company has been granted a local franchise.

BALATON, MINN.—The Balaton Telephone Company has been organized. James Morrison is president.

EXCELSIOR, MINN.—The Kinnetonka telephone line has been sold to the Northwestern Telephone Company of Minneapolis.

IONA, MINN.—The Enterprise Telephone Company, of Edgerton, is contemplating installing a farmers' line in this vicinity.

MINNESOTA LAKE, MINN.—The Citizens' Telephone Company is considering the matter of installing an exchange in this city.

ST. JAMES, MINN.—The Minnesota Valley Telephone Company has asked for a franchise to put a local telephone exchange in this city.

SHAKOPEE, MINN.—The Shakopee Telephone Company has been incorporated with a capital of $50,000 by J. B. Reiss and H. P. Fischer.

RED LODGE, MONT.—The Moffett Telephone Company has been taken over by the Mutual Telephone Company, of Billings, of which P. B. Moss is president.

GLENDIVE, MONT.—The Hughes Electric Company will install a telephone switchboard with double the capacity of the one now in use.

RICH HILL, MO.—The City Council has granted S. J. McComb a franchise for a telephone system in this city.

BEARDSTOWN, MO.—The Central Union Telephone Company is laying a cable across the Illinois River at this point. The telephone wires are to be removed from the bridge.

MONTICELLO, MO.—The stockholders of the Citizens' Telephone Company held their annual meeting and elected J. H. Blackburn, president; Harvey Burgess, vice-president; G. W. Vaughn, secretary; J. F. Gnuse, treasurer, and C. O. Raine, general manager.

CHILLICOTHE, MO.—The People's Telephone Company has been organized. The election of officers resulted as follows: P. F. Romeiser, president; W. B. Leach, vice-president and business manager; W. H. Ellett, treasurer, and R. L. Rawlins, secretary. The capital stock is $40,000.

CHILLICOTHE, MO.—Articles of incorporation of the Chillicothe Telephone Company changing it from a private corporation to a joint stock company have been filed. The company will capitalize for $40,000. The bulk of the stock is held by Col. W. B. Leach, original owner of half the exchange, and President W. H. Ellett, of the People's Bank, who recently purchased half interest from Dr. A. W. McArthur, of Kansas City.

ST. JOSEPH, MO.—St. Joseph and Cameron are now connected by three telephone lines. The Funston Long Distance Telephone Company opened the third line when its wires were connected with the central office of the Citizens Telephone Company. The line is 40 miles in length. Among the towns reached by the company are Stewartsville, Osborn, Hemple and Saxton. J. G. Funston, superintendent of the Citizens Telephone Company, is secretary and general manager of the Funston Company. E. B. Funston, of Racine, Wis., is its president.

ST. LOUIS, MO.—The Suburban Telephone Company, of Clayton, St. Louis County, Mo., has completed its connections with the Kinloch system in St. Louis, thus bringing the residents of Clayton in direct communication with all telephones belonging to the Kinloch Company. General Manager Houseman, of the Suburban Company, stated that the work of putting in telephones at Webster Groves would start at once, and that about 35 telephones were already in operation at Ferguson. Nearly 100 instruments are now being used in the county seat. All of these have direct connection with St. Louis telephones. The service in the county will be free, with a toll of 10 cents for connection with St. Louis. The Suburban Company has in use automatic telephones exclusively.

STANTON, NEB.—The Nebraska Telephone Company has sold out its interests to local capitalists.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company is finishing up three farm lines south of Elmwood, making seven farm lines running out from Elmwood.

ARGYLE, NEB.—The Argyle & Wayland Telephone Company is preparing to extend its line from the northern terminal point to Charleston and connect with the German-American. It will also extend a line into Croton.

CONCORD, N. H.—The new Automatic Telephone Company intends to have an exchange in this city.

CAMDEN, N. J.—The Delaware & Atlantic Telegraph & Telephone Company, has amended its certificate of incorporation, showing a capital of $397,945, fully paid in.

TRENTON, N. J.—The Interborough Telephone & Telegraph Company has been incorporated with a capital of $100,000. The incorporators are B. S. Mautz, H. S. Gould and others.

ROCHESTER, N. Y.—The Churchville Telephone Company, capital $5000, has been incorporated.

COHOES, N. Y.—A rural telephone system is to be established in Herkimer County by the Central New York Telephone Company.

UTICA, N. Y.—At the meeting of the directors of the Central New York and Empire State Telephone Companies, it was decided to expend $2,000,000 for additions and improvements to the telephone service in Central New York.

LEEDS, N. D.—The village has granted the telephone franchise to G. G. Gandee.

FARGO, N. D.—The Tri-State Telephone Company has presented a petition asking for a right of way through this city.

JAMESTOWN, N. D.—The Northwestern Telephone Company is preparing to build a line between this city and Bismarck next summer; also to build a line to Spiritwood Lake from this city.

FARGO, N. D.—The stockholders of the Red River Telephone Company have elected officers for the ensuing year as follows: President, P. H. Lamb; vice-president, L. H. Baker; secretary and treasurer, Leslie Welter.

FARGO, N. D.—The books of the Fargo exchange of the Northwestern Telephone Company, the last day of the old year, showed that there were 1555 subscribers in this city and Moorhead, against 1352 Dec. 31, 1903, an increase of 203. In addition there are 77 farmers, to whom subscribers in this city and Moorhead have access without any extra cost. It is thought that there will be considerable new work and extension in this territory during this year.

BRIDGEPORT, OHIO.—The Belmont Telephone Company has increased its capital of $75,000 to $150,000.

ST. CLAIRSVILLE, OHIO.—The Belmont Telephone Company has increased its capital stock from $75,000 to $150,000.

OSSIAN, OHIO.—The Uniondale Rural Telephone Company has increased its capital from $1300 to $13,000. V. M. Hatfield is president.

CLEVELAND, OHIO.—The Cleveland Telephone Company has decided to reduce the rental of individual residence telephones from $60 a year to $48.

VAN WERT, OHIO.—The Farm City Telephone Company has been organized, capital $20,000. Incorporated by F. W. Purmoth, J. A. Wilmore and others.

CHESTERHILL, OHIO.—The Chesterhill-Elliott Telephone Company has been formed with a capital of $3000. The incorporators are Hiram Hart, A. Strode and others.

CLEVELAND, OHIO.—The Crawford County Telephone Company has been formed with a capital stock of $2000. John F. Zimmerman, of Wickliffe, is president.

YOUNGSTOWN, OHIO.—The Youngstown Telephone Company has just completed new lines to Sharon and Greenville. About 800 new telephones have been installed during the past year.

GRATIOT, OHIO.—The annual meeting of the Gratiot & Brownsville Telephone Company was held at Gratiot last week. This exchange has been in operation about three months and connects with 160 subscribers.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has closed a deal for the purchase of the Collinwood telephone plant at Collinwood. The company had $40,000 6 per cent bonds and $40,000 stock. Both the bonds and stock were acquired by the Cuyahoga. The plant will be consolidated with the Cuyahoga Telephone Company and put in excellent condition.

COLUMBUS, OHIO.—General Superintendent M. S. Connors is planning a telephone system which will connect all of the Columbus offices of the Hocking Valley, Ohio Central and Zanesville and Western and also enable officials and trainmen by the use of the telegraph wires to communicate with all of the important points on the three roads, including East Toledo, the docks, Walbridge, Fostoria, Upper Sandusky, Marion, Delaware, Lancaster, Logan and Nelsonville. A contract for about 45 telephones will be placed. The system will not be used in the operation of trains.

ERICK, OKLA.—The Erick-Delhi Mutual Telephone Company, at its annual meeting, elected the following officers for 1905: C. M. Sutton, president; J. D. Warford, vice-president; Joseph Pyle, A. P. McCubbins, C. S. Yarberry, directors; J. D. Warford, superintendent. They decided to put in an exchange in Erick at once. Twelve dollars per year will be charged for residence telephones and $18 per year for telephones in business houses.

RAPID CITY, S. D.—Fred Charrlin proposes to build a telephone line from this city to Creston.

WHITEWOOD, S. D.—A private company, headed by C. C. Haas, a wealthy farmer, is about to be organized to build a telephone line from the Belle Fourche River to this city. Mr. Haas has already built two miles. The line will pass through a well settled district, and will be the only independent county line in the Hills.

BRYAN, TEX.—The East Dallas Telephone Company has been incorporated. Capital $30,000.

OGDEN, UTAH.—A new building, which will cost about $15,000, will be erected here in the near future by the Rocky Mountain Bell Telephone Company.

SALT LAKE CITY, UTAH.—Improvements to the amount of $700,000 will be made in the system of the Rocky Mountain Bell Telephone Company in this city during the present year.

SALT LAKE CITY, UTAH.—Circulars announcing a reduction in its rates for business telephones have been issued to patrons by the Rocky Mountain Bell Telephone Company. This action has resulted from the activity of a citizens' committee appointed some weeks ago at a mass meeting called for the purpose of securing concessions from the company.

CENTRALIA, WASH.—The People's Co-operative Telephone Company has been granted a right of way along country roads in this county to connect Olympia and Chehalis, and Olympia and Oakville.

GREENWOOD, WIS.—Q. S. Armstrong has applied for a franchise to build a telephone system in this city.

SUPERIOR, WIS.—At a meeting of the Council the proposition of the Bell Telephone Company to install its telephones in the City Hall free of charge was accepted.

VERNON, B. C.—The Board of Trade has under consideration a proposal from Geo. Williamson to put in a long-distance telephone system connecting Enderby, Armstrong, Vernon and Kelowna. The cost would be about $20,000 or $30,000, and Mr. Williamson will undertake it as personal venture if he can secure support from requisite number of people in the valley.

Electric Light and Power.

DOTHAN, ALA.—It is intended to install in the city electric light plant a 250-kw revolving field alternator and a 375-hp engine. The system will be changed from direct to alternating current, and 50 series enclosed arcs will be substituted for the 37 lamps now in use.

DADEVILLE, ALA.—The Tallapoosa Water Power & Electric Company has been formed to promote the development of 8000 horse-power on Tallapoosa River, in the vicinity of Sturdevant, for manufacturing purposes; capital, $500,000. Mrs. R. T. Parker, of Dadeville, is one of the incorporators.

COLTON, CAL.—A movement has been started here for a municipal electric light and power plant.

CALISTOGA, CAL.—G. S. Cutler, of Calistoga, has secured a franchise to construct and operate an electric light system.

SANTA BARBARA, CAL.—There is a movement on foot to establish a large electric lighting plant, and considerable local capital has been raised for the enterprise.

INDIO, CAL.—The Indio Light, Water & Ice Company proposes to construct water works, an electric light plant and a 10-ton refrigerating and ice plant. W. F. Everett is secretary.

SAN JOSE, CAL.—The National Park Electric Power Company has been formed by J. J. Inman, M. E. Page, W. H. Baugh and others. Capital, $250,000. The place of business is San Jose.

ARCATA, CAL.—The Arcata Light & Power Company proposes to purchase at once a complete equipment for transformer station including three 100-kw transformers, one 10-000-volt oil switch and 80 assorted sizes of meters, 5 to 10 amp.; probable cost $6000. H. L. Jackman, Eureka, is engineer.

LITCHFIELD, CONN.—The Litchfield Electric Light & Power Company will present a petition that its powers may be extended to include the town of Washington.

GLASTONBURY, CONN.—Lewis W. Ripley, for himself and others, has given notice that he will petition the General Assembly for a charter incorporating the Glastonbury Power Company, taking and using the water of Roaring Brook and its tributaries in the town of Glastonbury. The charter is also to contain a provision that the corporation now existing under the name of the Glastonbury Power Company shall be merged in the chartered corporation.

LEADVILLE, COL.—The McBride Electric Company, of St. Paul, Minn., has secured the contract for conduits and wiring for the U. S. Post Office at Leadville for $1247.

FT. VALLEY, GA.—Mayor J. L. Fincher is interested in the construction of an electric light plant.

McRAE, GA.—It is proposed to light Helena, Ga., by current taken from the municipal electric light plant of this place.

GREENSBORO, GA.—The Electric Supply Company, of Savannah, has secured the contract for constructing the municipal electric light plant for about $10,000.

COVINGTON, GA.—J. F. Henderson, C. C. Brooks and J. L. Whitehead compose a committee of the town of Covington, Ga., to take under advisement plans by which the city will be lighted by electricity about the middle of January. In connection with the lighting question at this place, it is rumored that local capitalists are considering the feasibility of developing the water power known as the White's shoals, on Alcovey River, ten miles distant, where there is believed to be sufficient power to light nearby towns and furnish power for a large part of the machinery of the section.

SAN FRANCISCO, CAL.—A brick central station has been completed in the grounds of the University of California at Berkeley, for the purpose of furnishing electric lights, power and heat for many of the University buildings. The plant, which is located on the bank of Strawberry Creek, has been constructed at a cost of $60,000, and is equipped with modern electric machinery, operated by a high-class steam plant. Besides supplying all of the arc and incandescent lights required on the campus, the plant will furnish current for the laboratories.

SAN FRANCISCO, CAL.—A report was recently circulated in San Francisco to the effect that H. H. Rogers, of the Standard Oil Company had purchased nearly all of the stock of the San Francisco Coke & Gas Company. It was also reported that the latter corporation had offered to purchase the San Francisco Gas & Electric Company's business, but failing in that, had made arrangements to commence a spirited opposition next summer in both electric and gas lighting. Leopold Michels, president of the San Francisco Coke & Gas Company, says that while contracts have been closed for $250,000 worth of gas mains, and gas will be cut from $1 to 60c. per thousand if necessary, he does not know of any recent change in ownership. He says, however, that Leopold Wallach, of New York, who represents the syndicate which reorganized the Coke & Gas Company, is one of several Standard Oil people owning stock. President Michels says he believes the report that an electric lighting plant will be installed in San Francisco by the interests controlling the San Francisco Coke & Gas Company. His intention is to give the consumer lower rates than are now prevailing. It is also reported on good authority that the new 9000-hp electric generating plant which has been nearly completed by the Mutual Electric Light Company, will be doubled in capacity.

WASHINGTON, D. C.—Bids will be received Jan. 24 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va.; Key West, Fla., and Pensacola, Fla., a quantity of arc lamps and electrical supplies, valves, incandescent lamps, wire, cable, conduit and fittings, ventilating sets, miscellaneous electrical supplies, etc. H. T. B. Harris, Paymaster-General, U. S. N.

WASHINGTON, D. C.—Speaker Cannon has received from Bernard H. Green, Superintendent of the Congressional Library, a report recommending the construction of a central power station to supply all the uptown Government departments in the vicinity of the White House with light, heat and power. The plan provides for the removal of all boilers and engines from the departments in question, and the establishing of a single distributing plant, with a system of conduits for the transmission of steam and electricity to the various scattered buildings. The estimated cost of the plant is $2,000,000, and it will cost about $200,000 a year to operate it.

ORLEANS, IND.—The Council has granted a franchise to the Heise Brothers, for the construction and installation of an electric light plant.

CAYUGA, IND.—A committee of inspection has been sent out to inspect electric light plants in other cities with a view of installing a plant in this city.

MARION, IND.—It is reported that the power plant owned by the Pittsburg-Columbia Oil Company, recently destroyed by fire, will be rebuilt, to be used for the generation of electricity.

SHELBURN, IND.—C. Wm. Whaley and Noland B. Stadley, Terre Haute, have secured a 20-year city and commercial lighting franchise in Shelburn. The plant will be located between Shelburn and Hymera.

INDIANAPOLIS, IND.—The Indianapolis Light & Power Company and the Marion County Water Heat Company have been merged. The capital of the combined organization is $1,000,000. A five-million-dollar bond issue is authorized.

RIVER SIDE, IND.—The Muncie Electric Light Company has secured the contract to light River Side for five years at $50 per light per year.

MARION, IND.—The power plant of the Pittsburg-Columbia Oil Company, recently destroyed by fire, will be rebuilt.

RICHMOND, IND.—Considerable interest is being manifest in the December report of the local municipal electric light plant. The receipts were $3,810.20 and the expenses $1,423; excess of receipts over expenses $2,387.14. The municipal company has had the street lighting since July.

ELKHART, IND.—C. G. Conn, builder and promoter of the Elkhart City Electric Company, has filed a mortgage on all his property as surety for a bond issue. Mr. Conn organized his company to compete with the St. Joseph Power & Electric Company and to destroy the electric combination of Northern Indiana. While he has been successful in annihilating his competitors it has proven a very expensive undertaking.

CHARITON, IA.—The city will rebuild the electric light plant at a cost of $40,000.

WATERLOO, IA.—The Waterloo & Cedar Falls Gas & Electric Light Company has been incorporated, with a capital of $595,000, with headquarters at Waterloo. It will engage in a general gas and electric business, and is incorporated with the principal object of constructing a gas plant at Cedar Falls, where a franchise was recently granted. Directors: J. H. Leavitt, G. E. Lichty, Geo. McLean and others.

LAKE CHARLES, LA.—The City Council is considering the establishment of an electric light plant.

OLD TOWN, ME.—There has recently been an increased demand for the electrical power in this city, resulting from the late reduction in rates. The Public Works Company, of Bangor, is at present installing motors in the canoe factory of the E. M. White Company, and at the Davis wood yard, and there will, in all probability, be several more placed in the city at no distant date.

BANGOR, ME.—Within the past few months the Public Works Company has made many improvements both in its car service and lighting departments. Since April, 1904, the company has spent about $100,000 and all of the improvements made, the lighting and car service departments share about equally. About $25,000 of this sum was expended for a storage battery plant which is located in the company's old offices in Park Street.

PORTLAND, ME.—At a meeting of the City Council committee on electrical appliances, E. T. Burrowes renewed his offer, made three months ago, to pay the city $25,000 for the privilege of building a conduit through Congress and Middle Streets. The committee informed him that a franchise could not be granted to an individual. A petition from the Consolidated Electric Light Company for a conduit franchise in the streets named is pending.

SNOWHILL, MD.—The Snowhill Electric Light & Power Company is about to enlarge the capacity of its plant to 1800 lights. Two 46-kw General Electric direct-current generators are to be installed.

MELROSE, MASS.—Mayor Buttrick proposes a municipal electric light plant and a city stable.

UXBRIDGE, MASS.—A new engine of 350-horse-power is being put in at the electric light station.

MELROSE, MASS.—Mayor Sidney H. Buttrick, in his annual message, recommended that steps be taken to establish a municipal lighting plant.

PITTSFIELD, MASS.—The Pittsfield, Mass., Street Railroad Company is considering a site for a brick power plant, which it will build at once. At present the power is supplied by the Pittsfield Electric Company.

MERRIMAC, MASS.—Merrimac has completed its system of waterworks and electric light plant. In addition to furnishing street lights for the town and stores and houses, the plant also furnishes power for a number of carriage factories.

NANTUCKET, MASS.—Charles Neal Barney, receiver of the Nantucket Gas & Electric Company, has filed a petition in the Suffolk County Superior Court, to sell all the real estate, personal property, franchise and other assets of the corporation.

FALL RIVER, MASS.—The Fall River Electric Lighting Company has bought 500 rods of land and wharf property at the foot of Hathaway Street, in that city. The company will erect a new generating plant at tidewater within the next two or three years.

MEDWAY, MASS.—The electric lighting plant of the Medway Electric Light & Power Company will be closed indefinitely. The mill privilege has

been conveyed to the Franklin Savings Bank by John F. Cronan, of Boston, treasurer of the company. Negotiations are now under way for the sale of the plant to the Medfield Electric Light & Power Company. If the sale is not consummated, the Medway company will purchase from the Medfield company and continue business as heretofore. Connections will be immediately made with the Medfield company's power station at Medfield Junction.

COLTON, CAL.—It is proposed to establish an electric lighting and power plant at Colton. City Trustee Knox says that the board is looking for additional water supply, the intention being to put in a big steam plant, install a dynamo and generate current necessary for needs of the town. The estimated cost is $40,000.

MARCELLUS, MICH.—Another engine will probably be installed in the municipal electric light plant in the near future.

CRYSTAL, MICH.—Mr. Otis A. Sanford, owner of the electric light plant here, contemplates adding a larger generator and boiler to his plant.

ANN ARBOR, MICH.—Ross Granger, city clerk, writes in regard to the lighting of the city streets, that plans are now being prepared but no definite action has yet been taken. Address Wm. Goodyear, alderman, for further particulars.

NORTHVILLE, MICH.—The Common Council has granted a franchise to C. A. Ward, of Ann Arbor, for furnishing electricity for lighting the streets and residences and power for factories in the town. The company will develop its electricity near Hamburg, on the Huron River, where it will build 3 dams. Generators will be placed at each dam, and the electricity turned into the feed wires which go to Northville, South Lyon, Ypsilanti, Ann Arbor and other points.

ST. PAUL, MINN.—Sealed proposals will be received at the office of the Constructing Q. M., this city, until January 21, for the construction of an addition to the electric power plant at Fort Snelling, Minn. R. M. Schofield, Construction Q. M.

HOUSTON, MISS.—An election will be held Feb. 2 to vote on issuing bonds for the construction of a combined water works and electric light plant. No engineer has been selected as yet.

BOZEMAN, MONT.—The Gallatin Light, Power & Railway Company will either entirely remodel its steam plant or install a water power plant during the coming summer.

OMAHA, NEB.—The Omaha Electric Light & Power Company has declared the regular semi-annual dividend of $2.50 per share, payable Feb. 1.

TONOPAH, NEV.—The Owens River Power Company has signed contracts for the erection of its proposed power plant, which will furnish electrical energy for the mines of this city and Goldfield. Work on the tunnel is almost completed.

BAYONNE, N. J.—Mayor Brady is said to be in favor of a municipal electric light plant.

SPRING LAKE, N. J.—Bids will be received Jan. 17 by the Borough Engineer, for furnishing and installing a 150-hp marine type boiler, air compressor, feed water heater, boiler feed pump, steam separators, etc., in power house at Spring Lake.

OSWEGO, N. Y.—The People's Gas & Electric Company has secured the contract for lighting the city for 5 years at $66 per arc light per year, and $3.65 per year for incandescent lights.

MIDDLETOWN, N. Y.—The Orange County Lighting Company, of Middletown, has been incorporated, capital $100,000. Incorporators: P. N. Jackson and Percy Ingalls, Newark, N. J., and T. L. Reeve, Middletown.

OXFORD, N. C.—Bids will be received by Henry A. Pressey, C. E., 1416 F St., Washington, D. C., on Jan. 25 for the construction of water works, an electric light plant and an ice plant at Oxford, N. C.

ASHEVILLE, N. C.—Contracts have been prepared for the construction of the long-talked-of electric railway from Asheville to Weaverville, N. C. It is stated that New York capital is interested in the enterprise.

ROCKINGHAM, N. C.—Hugh McRae & Company, bankers, of Wilmington, have purchased property along Pee Dee River, and will soon begin the development of Bluett's Falls, on the Pee Dee, to supply that section with electric power.

MINGO, OHIO.—The Water Works Company has decided to remodel the electric light plant.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company will expend about $500,000 in the West End, and about $200,000 in the East End.

TOLEDO, OHIO.—The Toledo Heating & Light Company contemplates extensions and improvements this spring, including the installation of an alternating current lighting system.

MT. VERNON, OHIO.—Mr. Hubbell and others have secured a franchise for an electric light plant, which will be constructed and operated under the name of the Citizens' Electric Company.

ZANESVILLE, OHIO.—The Board of Public Service has renewed the contract for city lighting for one year dating from October 27. The rate which will be paid is $73.50 per light. This is the same rate paid in the past.

BARBERTON, OHIO.—A new electric lighting plant may be installed in Barberton in a short time. The Barberton Inn owners, O. C. Barber, of Akron, and M. J. Alexander, of Pittsburg, hold a franchise granted them about a year ago by the Council which gives them the right to install an electric lighting plant and to wire the city. The plant of the Barberton Inn, which furnishes all the light for the big hostelry, is now being run at only an eighth of its capacity, and it could alone light and furnish electricity for the down-town section of town. The plan is to install a bigger plant at the Inn and to compete with the Northern Ohio Traction & Light Company.

OREGON CITY, ORE.—The Portland General Electric Company is preparing plans for the construction of a 40,000-hp electric plant at Willamette Falls, Oregon City. E. Hippeley, of Portland, is chief engineer.

STATE COLLEGE, PA.—The Nitanny Light, Heat & Power Company, of State College, has been incorporated, with a capital of $10,000.

PHILADELPHIA, PA.—The Commonwealth Electric Company, of Philadelphia, has been incorporated to supply light, heat and power, by means of electricity to Philadelphia, capital $100,000. Incorporators: Mark Hyman and Ross A. Mackey, New York, N. Y.; Graham Sumner, Englewood, N. J., and John M. Ingham, Philadelphia.

FLORENCE, S. C.—The Florence Improvement & Manufacturing Company contemplates making several changes to its plant, but as yet no definite plans have been laid down.

DEADWOOD, S. D.—Press reports state that the properties of the Black Hills Electric Light Company, of Deadwood, and the Belt Light & Power Company, of Leadville, are about to be purchased by a new company to be known as the Black Hills Consolidated Electric Light & Power Company. J. J. Henry, of Denver, Col., is negotiating the deal. The new company will probably make extensive improvements.

DALLAS, TEX.—The Dallas Electric Light & Power Company will build a new power house.

NEW BRAUNFELS, TEX.—Mr. Louis A. Voight, superintendent of the Landa Electric Light & Power Company, informs us that the company contemplates installing a new alternating current generator and switchboard at an early date.

GRANDVIEW, TEX.—The Grandview Mill, Light & Ice Company, of Grandview, has been incorporated with a capital of $20,000 to operate a corn mill, ice factory and electric light plant. Incorporators: W. B. Head, R. E. Pitts, T. E. Pittman and others.

MEMPHIS, TENN.—The Merchants' Power Company is reported organized, with a capital of $500,000 to build and equip a plant to supply private consumers. It will also construct a plant to supply the city, and will give the city the option of buying either or both plants.

MEMPHIS, TENN.—The Merchants' Power Company has been organized here, with a capital stock of $500,000, and a new lighting plant for Memphis now seems assured. The gentlemen interested are local bankers and merchants. The promoters will build one plant for the furnishing of light to private consumers and one for the furnishing of lights for the city. Upon completion of them the city will be given the option of buying either one or the other or both.

SALT LAKE CITY, UTAH.—Plans will shortly be submitted for the installation of an electric plant at Fort Douglas at a cost of approximately $40,000.

PAYSON, UTAH.—A special election will be held here on January 21 on a proposed bond issue of $12,000 for the improvement of the electric lighting system.

AMERICAN FORK, UTAH.—J. H. Wooten, Manager of the Utah County Light & Power Company, has prepared details for the erection of the proposed light and power plant in American Fork Canyon. It will be operated by both water and steam, and the cost is about $400,000.

RUTLAND, VT.—The Rutland City Electric Company is setting poles and stringing wires to North Clarendon for the purpose of furnishing electric lights to a number of residents at that place and possibly at a not far distant date the streets of the town will be lighted with electricity.

ST. ALBANS, VT.—The electric power from Fairfax Falls, eight miles distant, which has been turned on in this city, has been tested on the arc light circuit and is now in use on the incandescent circuit and for motor purposes. In the construction of this plant at Fairfax Falls about $125,000 has been expended by the Vermont Power & Manufacturing Company.

SPOKANE, WASH.—Jay P. Graves and the syndicate backing the Spokane Interurban System are figuring upon installing an electric power plant at Nine-Mile Bridge, on the Spokane River, nine miles below Spokane. Cliffs on either side of the river rise to a height of 90 feet, and a 70-foot dam can be put in to develop 40,000 horse-power. The site and water rights for six miles above the cliffs have been secured for $15,000. The Westinghouse Electric Company has had a man investigating the site and is designing machinery for a 14,000 horse-power plant there. The same company is designing the machinery for the electric railway to Moscow, Ida.

ALMA, WIS.—The Alma Electric Light Company has been incorporated with a capital of $5000. Incorporators: John Harry, Russell N. Smith and Frank Harry.

CADOTT, WIS.—The Cadott Light & Power Company, of Cadott, has been incorporated, with a capital of $4000, by R. B. Cunningham, J. A. McGillivray, H. W. Frasl and others.

ST. THOMAS, ONT.—The citizens have voted to purchase the St. Thomas gas and electric light plant for $205,000.

OTTAWA, ONT.—The Temiscamingue & Mechiskan Dam Company, of Ottawa, has been incorporated with a capital stock of $100,000, for the purpose of establishing a hydro-electric power plant at the southern outlet of Lake Temiscamingue. Among the incorporators are Sir A. P. Caron, C. B. Powell and E. B. Eddy.

OTTAWA, ONT.—An important Canadian electrical trust scheme is now being mooted in Ottawa which contemplates the amalgamation of some seven or eight electrical and power interests, operating in the Ottawa district. The joint capitalization of the companies to pool their interests approaches $10,000,000. The names of the companies mentioned as likely to form the combination are the Ottawa Electric Company, Ottawa Electric Railway, Consumers' Electric Company, Hull Electric Company, the Hull Electric Street Railway, the Capital Power Company, of Deschene, the Hull, and the Ottawa Power Company. It is the matter of water power that will make the proposed merger an economic move for all concerned, as the scheme involves the development of the water power of the Chaudiere.

The Electric Railway.

STOCKTON, CAL.—The Stockton Electric Railroad Company has entered into an agreement with the West End Improvement Company to build an extension to Poplar and Stockton Streets into the heart of West End tract.

LITCHFIELD, CONN.—Among the petitions to be presented to the incoming Legislature is one from the Litchfield & Torrington Tramway Company for a renewal and extension of its charter.

WILLIMANTIC, CONN.—William A. Buck and Colonel Marvin H. Knowlton of this city and George O. Jackson, of Norwich, ask for a charter for the Willimantic & Stafford Street Railway Company, the line to run from Willimantic to Stafford Springs. The petition also asks for a charter for a line extending from Jackson Street, Willimantic, to Mansfield Center, thence through Spring Hill to South Willington to connect with the Stafford line.

HUNTINGTON, IND.—The Huntington, Columbia City & Northwestern Railway Company has been incorporated with a capital stock of $25,000. The line will be run from this city through six cities to Lagrange.

WASHINGTON, D. C.—An order has been issued by the Capital Traction Company and the Washington Railway & Electric Company announcing to the conductors and motormen employed by the two corporations that their wages have been increased. The wages of the employes of the Capital Traction Company were advanced 25 cents a day, or from $2 to $2.25. The raise made by the Washington Railway & Electric Company was on a somewhat different basis, 20 cents per hour being given, instead of 18 cents, as heretofore. It is explained that the companies made the advance because of a marked increase in their receipts and a desire to share the profits with their faithful employees.

BLOOMINGTON, ILL.—The Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company, of this city, has changed its name to the Springfield & Northwestern Railway Company, and increased its capital from $300,000 to $900,000.

GRANITE CITY, ILL.—The Granite City, St. Louis & Eastern Belt Railroad Company has been organized. The incorporators and first board of directors are F. G. Niedringhaus, H. F. Niedringhaus and William F. Niedringhaus, of St. Louis, Mo., and W. W. Hanlon and C. F. Stelzel, of Granite City, Ill.

CHICAGO, ILL.—The Chicago Subway Company has announced the following directorate of the Illinois Tunnel Company: A. J. Earling, president Chicago, Milwaukee & St. Paul Railway Company; E. P. Ripley, president Atchison, Topeka & Santa Fe Railway; George H. Harris, president Chicago, Burlington & Quincy Railway; H. M. Felton, president Chicago & Alton Railway; J. Kruttschnitt, director of maintenance and ways, Southern Pracific and Union Pacific Railway; R. L. Winchel, president Rock Island Railway; A. C. Bird, vice-president Gould lines; F. D. Underwood, president Erie Railway; Benjamin Thomas, president Chicago & Western Indiana Railway; P. A. Valentine, vice-president Armour & Company; Albert G. Wheeler, president Illinois Tunnel Company. The Chicago Subway Company owns the stock of the three operating companies connected with the subway. These consists of the Illinois Tunnel Company, which will operate the tunnels; the Illinois Telephone Construction Company and the Chicago Warehouse & Terminal Company, which will handle all the warehouse and terminal business in connection with the tunnel.

MUNCIE, IND.—A fifty-year franchise has been granted to the Muncie & Newcastle Traction Company by the Delaware County Commissioners.

GLENWOOD, IA.—Col. James A. Swope, L. B. Hanson and Prof. A. J. Howe comprise the directorate of the proposed Iowa & Nebraska Interurban Electric Transit Company, which will build between Rockport, Mo., and Omaha, touching Sidney, Hambury, Taber, Glenwood and Malvern, Ia., and crossing the Missouri River at a point opposite Bellevue, Neb.

LOUISVILLE, KY.—The Louisville Railway Company announces that its line to Pleasure Ridge will be extended to Valley Station.

LEXINGTON, KY.—At public sale a few days ago the entire assets of the Blue Grass Consolidated Traction Company were purchased by the creditors for $2807. With the exception of 700 railroad ties sold to W. Bush Nelson for $350, everything went to Clifford D. Bebee, of Detroit, Mich., one of the original, incorporators and the chief creditor, upon whose petition the Fayette Circuit Court placed the insolvent company in the hands of the receiver.

NEW ORLEANS, LA.—The New York Securities Company has begun suit in three different States, it is said, for the appointment of receivers for the street railways company of New Orleans, La., where, it is added, the State recently sought to annul the corporation, which desired to consolidate all of the city lines with a capital of $80,000,000. President E. C. Foster and Pearl Wright were named receivers, the application for the receivership growing out of an alleged attempt to over-bond the merged companies.

BRIDGTON, ME.—The railroad commissioners have approved the articles of association of the Brigton Street Railroad Company formed for the purpose of constructing and operating a street railroad from the landing on the shore of Long Pond, of the Sebago Lake and Songo River and Bay of Naples Steamboat Company, through the town of Bridgton to a point on Main Street near the Bridgton House. The company asks permission to operate the road by electricity, or animal power. The capital stock is $6000 and the road will be a mile and a half long. The incorporators are Charles L. Goodridge, Nellie L. Goodridge, Llewellyn Barton, Charles E. Cobb, Lyman B. Chadbourne and Fred C. Knight.

FREDERICK, MD.—The Frederick & Baltimore Electric Railway Company expects to extend its lines.

NILES, MICH.—F. M. Gray, a capitalist of this city, has started to form a company to build an electric railway west from Buchanan to Michigan City, Ind.

GRAND RAPIDS, MICH.—The Kalamazoo & South Haven Traction Company will build a line from Saugatuck through South Haven to Paw Paw Lake, to cost $2,200,000. G. B. Bardeen, C. W. Williams and others hold the franchise.

BAY CITY, MICH.—The Detroit & Bay City Traction Company has asked the Common Council for a three-months' extension of its franchise. The reason for the request is said to be the delay in the approval of the company's maps by the State Railroad Commissioner.

MENOMINEE, MICH.—William A. Lombard, of New York, representing Boston capitalists, has notified Mayor Cruse of the intention of his company to apply to the City Council of Iron Mountain, Mich., for a franchise authorizing the construction and operation of an electric street railway within the limits of the municipality. Authority to establish an electric lighting and a gas plant may also be requested. As planned, the railway is to be part of a continuous line connecting Niagara, Quinnesec, Norway, Vulcan, Loretto and other nearby Menominee iron range towns.

HATTIESBURG, MISS.—An interurban railway is projected from Hattiesburg to Laurel, 29 miles. Address C. J. Abbott for further information.

SPRINGFIELD, MO.—W. B. Sanford has closed a deal in St. Louis whereby he, with L. H. Hurray and H. B. McDaniel, local capitalists, purchased $270,000 of the stock of the Springfield Traction Company. The balance of the stock, $130,000, will be bought later on. The new company will absorb a rival line, leaving but one street car system in town. The retiring stockholders are R. C. Kerens, Moses Rumsey, S. W. Fordyce and George W. Parker, of St. Louis, and Senator S. W. Elkins, of West Virginia.

COLUMBUS, OHIO.—The Buckeye Street Railway Company has been incorporated by J. H. Vanderveer, E. H. Gray and others. Capital $1000.

DAYTON, OHIO.—The property of the defunct Dayton & Kenton Traction Company is to be sold at receiver's sale. It consists of options, plats, profiles and office furniture appraised at $1200.

CINCINNATI, OHIO.—The United States Circuit Court here has named Myron H. Wilson and Jacob G. Schmidlapp receivers for the Columbus, London & Springfield Railway, the Dayton, Springfield & Urbana Traction and the Central Market Street Railway of Columbus. The roads are part of the Appleyard system of trolleys.

LIMA, OHIO.—E. S. Nichols, receiver for the Sandusky Southwestern Railway Company, has filed a petition stating that the company is insolvent and unable to pay its debts and asking for an order for the sale of the real and personal property, rights of way, etc. The report of an engineer shows the company owns 22.35 miles of right of way between Wapakoneta and Kenton, of which 20.81 miles have been graded and 17.57 miles of right of way between Lima and Bellefontain, of which 2.86 miles are graded. The receiver states in his petition that bonds to the amount of $1,500,000, executed and delivered to a Cleveland trust company, secured by a mortgage on all the property of the company, were never certified to by the company, as required by law, hence he claims the mortgage is of no value.

POTTSVILLE, PA.—The Pottsville Union Traction Company has given orders for the construction of a trolley road, 8½ miles in length, from St. Clair to Franckville.

CHARLESTON, S. C.—The City Council has granted the Charleston & Summerville Electric Railway Company a franchise to lay tracks and operate cars through certain streets and thoroughfares of the city.

BROWNSVILLE, TEX.—A franchise has been granted to residents in Brownsville for installing an electric railway system for the city. The plant is guaranteed to be in operation by April 1.

SAN MARCOX, TEX.—Steps are being taken to build an electric railway from San Marcos to Luling.

POMEROY, WASH.—The Pomeroy-Clarkston Electric Railway Company is soon to be incorporated for the purpose of building, equipping and maintaining an electric railway between the cities of Pomeroy and Clarkeston. William McCarroll, V. D. Norman, A. S. Burnett and others are interested.

SPOKANE, WASH.—The Washington Water Power and the Spokane Traction Company are having a desperate fight for franchises in this city. The Spokane Traction Company secured a franchise last spring to build for a mile-and-a-half along one side of Third Avenue and now the superior court has declared valid an unused franchise to the same street, granted the Washington Water Power Company in 1890.

SPOKANE, WASH.—The Spokane interurban system, the new electric road proposed between this city and Moscow, Ida., have elected officers as follows: President, Jay P. Graves; vice-president, F. A. Blackwell; treasurer, Hiram B. Ferris, and secretary, Will Davidson. A meeting of the most prominent merchants, bankers and manufacturers of this city has endorsed the project and stock is being subscribed at $100 per share. The road will be built entirely by local capital if such can be secured. It will cost about $3,250,000.

GRAFTON, W. VA.—A charter has been issued to the Grafton Construction Company, with a capital stock of $25,000, to do a general contracting business. The incorporators are W. E. Harton, George W. Powell, Thomas F. Jobe, T. B. Bradshaw and W. E. Hildebrand, all of Pittsburg. This company proposes to build a street railway in the city of Grafton.

TORONTO, ONT.—The receipts of the Toronto Electric Street Railway Company for the year 1904 amounted to $2,411,747. This shows an increase of $257,306 over the total receipts for 1903, and an increase of $599,091 over the year previous.

MONTREAL, QUE.—The Montreal Street Railway has arranged for the expenditure of $500,000 during the year 1905 in securing and distributing additional electrical power and making improvements over its system. An important project, which will greatly improve the company's power facilities, calls for the erection of three sub-power stations at different terminals of the system. Each sub-station will have a capacity of 1000 horse-power, thus enabling the company to put any number of cars on all parts of its system at any time during the day.

New Industrial Companies.

THE GENERAL LIGHT SUPPLY COMPANY, of West Hoboken, N. Y., has been formed, capital $10,000. It was incorporated by K. Engle, M. Heyman and others.

THE ROCKLIFF MOTOR TRACK COMPANY, of Brooklyn, has been formed; capital $50,000. Directors: S. D. Van Wagner, C. H. Patterson and Charles Rockliff, Brooklyn.

THE CONTINENTAL MOTOR COMPANY, of Boston, Mass., has been incorporated with $1,000,000 capital stock. President, Albert H. Knowlton; treasurer, Harold P. Knowlton.

THE SEABOARD ELECTRIC EQUIPMENT COMPANY, of New York, has been formed with a capital of $50,000. Directors: S. B. Smith, New York; D. H. Patton and D. G. Patton, Yonkers.

THE IROQUOIS MOTOR CAR COMPANY, of Syracuse, has been incorporated, capital $450,000. Directors: Thomas W. Pelham, Buffalo; Charles P. Blanchard, Syracuse; Leonard F. Mahan, Fayetteville.

THE GUARANTEE TELEPHONE & EQUIPMENT COMPANY, Chicago, Ill., has been organized for the manufacture of telephone and electrical supplies. The incorporators are L. Anderson, Albert Duce and Donald E. Turner.

THE TRITT ELECTRIC COMPANY has filed articles of incorporation at South Bend, Ind., to manufacture automobiles and appliances and electric specialties of all kinds. B. E. Tritt, A. M. Calvert and W. B. Persling are the incorporators.

THE SCHAPER CONSTRUCTION MATERIAL COMPANY, of New York City (telephone and other electrical apparatus), has been incorporated with a capital stock of $25,000. The directors are John H. Schaper and George Schaper, of Brooklyn, and August R. Ermisch, of Long Island City.

THE MAIER-OLIPHANT ELECTRIC COMPANY has incorporated at Indianapolis, Ind., with a capital stock of $5000. The company will do all kinds of electrical and mechanical construction, manufacturing and repairing in Indianapolis. Frank L. Maier, S. H. Oliphant and Louis Maier are the directors.

THE NORTH JERSEY ELECTRIC LIGHT, HEAT & POWER COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000, to manufacture and distribute electric current for light, heat and power. The incorporators are Frank J. Smith, Benj. F. Tracy and John O'Regan, Jersey City.

THE NEWTON MANUFACTURING COMPANY, of Kittery, Me., has been organized for the purpose of manufacturing and dealing in hardware, electric and other specialties with $500,000 capital stock, of which nothing is paid in. The officers are: President, O. Sumner Paul, of Kittery; treasurer, Jesse E. Forsyth, of Kittery.

THE RAILWAY & LIGHT SECURITIES COMPANY has been organized at Portland, Me., for the purpose of constructing and operating street railways, lighting and power plants, and dealing in the securities of the same, with $2,200,000 capital stock, of which nothing is paid in. The officers are: President, Robt. A. Jackson, of Boston, Mass.; treasurer, Chas. M. Drummond, of Portland, Me.

Legal.

STOCK TICKER DECISION.—Judge Fisher, in the U. S. Circuit Court at St. Louis, has dissolved the temporary injunction granted the Cella Commission Company against the Western Union Telegraph Company last August by Judge McDonald, sitting in chambers, to compel the Western Union and Gold & Stock Telegraph Companies to deliver to plaintiff quotations from the New York Cotton Exchange. The telegraph companies contended that as servants of the New York Cotton Exchange they had no right to violate their instructions to the effect that quotations should not be furnished to alleged ""bucket-shops" or places that dealt in bets on fluctuations of the market.

BATTERIES FOR HORSE RACES.—A case came up in the Cincinnati courts recently over a battery for race horses. Suit was brought by an employee for overtime spent on experimenting with the device. The battery, which was produced in court, is but little over an inch long. It is made of glass and is less than half an inch in diameter. It developed during the testimony of the employe that the battery was made upon the order of a horseman, who, he alleged, desired to use it to "make a killing" at the race tracks. "It was intended to be attached to a horse in such a manner that it would produce a continual shock and cause the animal to run as it had never run before."

Obituary.

MR. LLOYD LOWNDES, ex-Governor of Maryland, a wealthy banker and Republican leader, has just died, sixty years of age. He was president of the Frostburg, Md., Gas & Electric Light Company, and was interested in the Cumberland, Md., Electric Street Railway Company as a director.

MR. E. L. PHILLIPS.—Mr. Edward Lindon Phillips, president of the Hewes & Phillips Company, engine manufacturers of Newark, died suddenly recently at his home, in Chatham, N. J., of apoplexy, at the age of 54 years. He had been sailing an iceboat all the afternoon on the frozen meadows in Chatham, and while passing through Chatham Village on his way home was seized with a sudden attack of faintness. Another attack came upon him when he reached the house, and he died in a few minutes. Mr. Phillips was born in Newark and was a son of John L. Phillips, a well-known manufacturer. He graduated from Cornell, and when his father died, in 1886, he was made president of the company. He leaves a widow and two daughters.

Personal.

MR. A. L. ENGLISH has been made manager of the Citizens' Gas & Electric Company, of Council Bluffs, Ia.

MR. F. M. SHELLEY has resigned as vice-president, etc., of the Rome Gas, Electric Light & Power Company, of Rome, N. Y.

MR. MAX LOWENTHAL has been awarded a bronze medal by the St. Louis Exposition in recognition of his work in promoting the development of the electric heating art.

MR. J. H. REID, of Newark, N. J., has been in Worcester, Mass., with the object of interesting New England capital in his dynelectron invention for generating current directly from heat.

MR. W. P. BEYERLE has resigned as manager of the Council Bluffs Citizens Gas & Electric Company, to accept a position with the Maryland Telegraph & Telephone Company, of Baltimore, Md.

MR. HENRY C. MORTIMER, JR., of the General Electric Inspection Company, has jointed the New York office staff of the Crocker-Wheeler Company. He will assist F. B. DeGress, manager of that office.

MR. R. B. ELDER, manager of the Wagner-Bullock Electric Company of California—carrying the Coast Agency for the electrical business of the Allis-Chalmers Company—has returned to San Francisco, after visiting Cincinnati, Ohio, on business.

MR. H. C. HUTCHINSON, well known in electrical circles as manager of the promotion department of the Cincinnati Gas & Electric Co. has resigned. His successor is Mr. Edward Miller. Mr. Hutchinson's plans for the future are not announced.

MR. BION J. ARNOLD has been retained as consulting engineer by the City of Chicago to make an exhaustive study and report on the possibility of deadening noise on the Union Loop in that city, and also on the practicability of the through routing of cars on the elevated lines.

MR. ARTHUR R. BUSH has resigned as New England district engineer of the General Electric Company, to accept an executive position with the Union Bag & Paper Company. The headquarters of Mr. Bush will be at the general offices of the company, 17 Battery Place, New York.

MR. C. J. PURDY has severed his connection with the Munder Electric Company as its New York sales agent and has become general manager of the American Incandescent Lamp Company dating from January 16, after which time the American offices will be located on the ground floor of the Havemeyer Building, 26 Cortlandt Street.

SIR THOMAS FRASIER, K. C. B., of the Royal Engineers, who entertained the American Institute of Electrical Engineers at Chatham when it visited England in 1900 is now in the United States, and has been calling on his electrical friends in New York. He was dined this week by Sir Percy Sanderson, the British Consul here.

MR. HENRY A. REED, for so many years past prominently and successfully identified with the technical administration of the Bishop Gutta Percha Company, of New York City, and well-known as an expert on wire and cable insulation, has been elected president of that corporation, in which he has already filled virtually every other office. He will also continue as treasurer of the company.

MR. F. M. HUBBELL, who is largely interested in the electrical, trolley and other developments at Des Moines, Iowa, is the subject of a very interesting article in the newspapers east and west. He has been a leading factor in the upbuilding of one of the most prosperous cities of the Northwest. He is a native of Indiana and went to Iowa in 1858. The properties are managed by his son, Mr. F. C. Hubbell.

MR. S. L. COLES, well known in the electrical journalism of the East, and as an able all-round newspaper man, has purchased the *Railway and Marine News*, of Seattle, Wash. It is an excellent paper published twice a month with a good circulation, and is the only publication of the kind on the Coast. The paper is already prosperous and Mr. Coles is sure to push it forward and make it a power in the community and in the interests it represents.

FERGUSON & KILLION COMPANY, INC., is the name of a new firm recently organized in Philadelphia for the purpose of building complete power plants, including boilers, engines and electric machinery, with offices at 612-613 Betz Building, Philadelphia. Mr. Frank Ferguson has for some time been well known as a builder of boilers and engines, and Mr. Daniel Killion is also well known in the electrical field. The company has already secured a number of gratifying contracts since opening its office the first of the year.

MR. CHARLES N. BLACK, chief engineer of the Metropolitan Street Railway Company, of Kansas City, Mo., has been appointed general manager of the company, and hereafter will act in the dual capacities of chief engineer and general manager. In 1888 he was graduated from Princeton with the degree A. B. For the next two years he studied under Professor Brackett and secured the degree of E. E. He was afterwards connected with the Brush Electric Company, the Short Electric Railway Company, the Walker Company, and Ford, Bacon & Davis.

MR. JAMES G. ROBERTSON, who for fifteen years past has been representing A. L. Ide & Sons and Ideal engines in the West, at St. Paul, Minn., has been made New York manager and has established headquarters at Room 1406 Bowling Green Building. His brother, Mr. A. R. Robertson will continue in charge of his western Ide interests. In the New York territory, Mr. Robertson will have associated with him Mr. G. B. Ferrier, Jr., and Mr. Stuart J. Fuller, the latter of whom was lately connected with Westinghouse Traction Brake interests, and both of whom are active young engineers. The new combination bids fair to secure for Ideal engines a thorough representation in this important field and an adequate share of the business that offers in this line.

News of the Trade.

WIRT ELECTRIC COMPANY, of Philadelphia, has removed its New York office to 15 Cortlandt Street where it carries a complete stock of rheostats, dimmers and brushes.

SCHAEFFER & BUDENBERG MFG. COMPANY, maker of gauges, instruments of precision, etc., for steam engines and boilers, has been awarded a grand prize at the St. Louis Exposition for its apparatus.

CATALOGUES AND PRICES WANTED.—Albert Rothermel is opening a store at 686 East 149th Street, Bronx Borough, New York, and asks that catalogues and prices for electrical supplies and hardware be sent to him by manufacturers and wholesale houses. He proposes to carry a large stock.

EXHAUST HEADS AND FILTERS.—The Burt Manufacturing Co., of Akron, Ohio, has just shipped one 20-inch exhaust head to the Crane Company, Chicago, and another of the same size to the large power house at San Jose, Cal.; also one of its large Cross oil filters to the U. S. Coal & Coke Company for use in its mines in West Virginia.

THE CHICAGO FUSE WIRE MFG. COMPANY, through Mr. W. R. Goodman, reports a very steady increase in its business and a bright outlook for 1905. This company carries a full stock at its Eastern headquarters, 853 Broadway, New York, consisting of fuse wire and fuse strip, fuse links (regular and special), enclosed fuses, telephone fuses and blocks, wire joints and paper insulators, switch outlet boxes, etc. This has been found a great convenience to Eastern buyers, ensuring much more prompt delivery.

CONOVER CONDENSERS.—The Watson Machine Company, Paterson, N. J., announces that it has secured the full line of patterns and drawings, machine tools, jigs, etc., and all personal property and good will of the Conover Manufacturing Company, which heretofore manufactured these condensers, together with the services of Mr. E. K. Conover as manager of this condenser department. Mr. Conover has been identified with the origin and development of the condenser. The new erecting shops of the Watson Company will have a 25-ton crane with a 40-foot span and a runway of 150 feet, with a clearance of 30 feet under the hook.

THE ELECTRIC CONTROLLER & SUPPLY COMPANY, Cleveland, Ohio, has placed Mr. Geo. Magalhaes in charge of its Eastern office at 136 Liberty St., New York City. Mr. Magalhaes is a graduate of the Columbia University and has been connected with the engineering department of the company for some time. He is thoroughly familiar with the company's products, chief of which are reversing controllers, solenoids, lifting magnets, magnetic switch controllers for reversing or non-reversing motors driving heavy machinery, direct connected variable speed motor drive for planers, etc. Eastern customers and friends should address the New York office direct.

HOLTZER-CABOT ELECTRIC COMPANY.—The Brookline, Mass., "Chronicle" of Dec. 31, contains a history of the Holtzer-Cabot Electric Company, which is one of the standard institutions of that place and which, as our readers know, has a commanding position in the field of electrical manufacture. The portraits of the executive and engineering staff are shown on the front page, and of the numerous foremen on the back page. The history of the growth of this prosperous and well-managed concern is given in the body of the paper. President Holtzer is to be congratulated on having surrounded himself with such a handsome and intelligent-looking force, and on adding so successfully to the electrical industries of Massachusetts.

EDWIN H. LUDEMAN & COMPANY.—The firm of Edwin H. Ludeman & Company has succeeded Mr. Edwin H. Ludeman and will continue the business and representation of the latter as heretofore. Messrs. Edwin H. Ludeman and Oscar H. Ludeman are the principals of the new concern which will represent the New York interests of Robert Wetherill & Company, builders of Corliss engines, Corliss pumping engines and air compressors of Chester, Pa., the Williams engine, the Fitchburg (Mass.) Steam Engine Company four-valve automatic and vertical engines, and the Houston Stanwood & Gambel Company slide valve engines of Cincinnati, Ohio. The offices of the Ludeman firm are in the Taylor Building, 39-41 Cortlandt Street.

THE EUREKA ELECTRIC COMPANY, Genoa, Ill., has just recently put on the market their new improved Carter test set, which has several new features combined making it one of the most successful test sets now on the market. It reports heavy sales during the past month. This set is equipped with a combined pulsating and alternating current generator, a buzzer, two keys and a watch case telephone receiver. These keys are so connected that the test set may be used for testing on series, bridging or four-party selective lines. The keys also enable the talking set to be cut in and out of the circuit at pleasure. These features combined make a very desirable test set and give it a wide range of usage. The firm will be pleased to forward one on thirty days' trial. Any telephone exchange desiring such an apparatus should look into the merits of this set.

W. N. MATTHEWS & BROTHER, 801 Carleton Building, St. Louis, the enterprising manufacturers of the Stombaugh guy anchors, are making an offer to telephone, electric light and street railway companies which is, they say, getting many new customers for them. When they find a man who is doubtful of the holding ability of the Stombaugh guy anchor they ofier to let him screw one of their anchors in alongside of a "deadman." Taking the strain off the "deadman," they put it on the anchor, in such a manner that if the anchor does not hold, the strain will go back to the "deadman" and no damage will result. If the anchor does not hold it may be returned by freight at their expense. They expect a convert and payment for the anchor if it does hold. Thirty days is the time allowed for testing. They state that this test almost invariably results in a new customer.

ASBESTOS PACKINGS.—The H. W. Johns-Manville Company, New York, has just placed on the market two additions to its already very complete line of asbestos packings. These are known as "Kearsage" spiral high pressure piston and valve rod packing, and "International" hot water pump packing. The "Kearsarge" spiral packing is an old friend in new guise. It is the "Kearsarge" asbestos and rubber wound cloth coil packing, so well and favorably known to the trade, put up in spiral form to meet the growing demand for that type of packing. It has proved its merits as an efficient and durable packing on piston and valve rods, against high pressure, high temperature, and high speed. The "International" is a specially prepared and treated packing for use on pumps handling water at high temperatures and on piston and valve rods of engines against wet steam. This material has been tested under actual working conditions for over a year and has been found to be satisfactory in every respect for the service mentioned. The manufacturers have prepared attractive literature descriptive of these two packings which they will be glad to send to anyone interested.

SWITCHBOARD MFG. COMPANY.—It has been stated in these columns through error that the Switchboard Manufacturing Company, No. 24 New Chambers St., New York, had secured the order for the switchboards and panel boards at No. 60 Wall Street, but it appears that this company's installation there is confined to the panel boards and large distribution boards alone. Subjoined is a remarkable list of such work done by the concern in leading buildings in New York City: Lawyer's Title & Ins. Company Building; Manhattan State Hospital; Guggenheimer residence, Long Branch; Mauser Mfg. Co., Mt. Vernon; Carnegie Library, Brooklyn; N. Y. State Hospital; H. H. Vought & Co., New York; Apartment House, 61st St. and Broadway; Eagle Pencil Co.; Napanoc Reformatory; Woodbull Building; J. W. Flagler, Brooklyn; Troop C. Armory, Brooklyn; W. K. Vanderbilt, Oakdale, L. I.; Daly's Theatre, New York; People's Theatre, New York; Abattoir, N. Y. Butcher's Ass'n, New York; Racquet and Tennis Club; L. Sachs Building; Cooper Building; The Aquarium; Frankfield Building; Murray Hill Hotel; Einstein, Wolf & Co.; O. H. P. Belmont; Liebman's Brewery; Tiffany Garage; Architectural League; Revellion Freres; Varick Building; Methodist Book Concern; Long Island R. R.; F. H. Goodyear; N. Y., N. H. & H. R. R. Shops, Readville; also at Warren, R. I.; Mt. Prospect Pumping Station; Springfield Pumping Station; Jamico Pumping Station; Atelier Building; Black Building; Sills Building; Street & Smith; Mulligan & Higgins Glue Co.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., is building motor starting panels which are equipped with switch fuses, starting box, and with protective devices. They are briefly described by the following specifications: Each panel shall consist of a marbleized slate base at least ¾-in. thick, having mounted upon same one "overload" and "no-voltage" release motor starter, one double pole, single throw copper switch, and two enclosed fuses. The motor starter must fulfill the following specifications: The "overload" release must be a circuit-breaker and must protect the motor during the period of starting as well as in the running position. The "no-voltage" release magnet must respond solely to the line voltage and must be entirely independent of the field or armature currents. To prevent arcing upon the first live contact, there shall be furnished an independent, spring-actuated, renewable, circuit-closing switch, which breaks the circuit with a quick break on all sizes and with quick break and magnetic blow-out on sizes above 10 horse-power. All the stationary contacts shall be of segment form, readily removable and renewable. The starting lever contact shall be of the self-aligning, renewable skate shoe type. The starter must stand without injury or alteration a current of 50 per cent. in excess of the full load motor current when passed through the entire resistance when cold, for one minute. The starter must stand without injury or alteration a current which is double the full load motor current when passed through the entire resistance when cold, for twenty seconds. It must be absolutely impossible to make a fire in case the resistance be burned out by overload current. The insulating material must not smoke or smell when tested as above. These panels present a handsome appearance and have been installed in the St. Regis Hotel and in the new Astor Hotel, both in New York. The panel has been adopted as the United States Government standard.

Trade Publications.

THE CONDIT ELECTRICAL MFG. COMPANY, Boston, Mass., has issued a very neat catalogue illustrating the various types of oil circuit breakers made by it, and which have met with such general favor wherever used throughout the country. The catalogue is handsomely gotten up and reflects great credit on the concern it represents.

ELECTRO DYNAMIC COMPANY, of Bayonne, N. J., and 11 Pine Street, New York, has just issued illustrated circulars Nos. 1 and 3, series B, relative to its new "interpole" variable speed motor which has recently been described in our pages. The treatment in these pages is very full and explicit. Sparkless commutation is obtained by means of the interpoles.

THE C & C COMPANY has just completed a full line of type "S" motors and dynamos, and reports a large increase in business, December sales being nearly 50 per cent. greater than those of any other month during the past year. Among the many recent orders is one for some 40-odd motors, aggregating between 800 and 900 horse-power, 28 of which are of the variable speed type.

PASS & SEYMOUR, INC., of Solvay, N. Y., are issuing a complete new price-list covering all of their material. This list is up to date and contains considerable valuable information. List No. 81 covers their porcelain tubes, cleats and regular standard porcelain. List No. 82 covers their complete line of brass shell sockets, receptacles, weatherproof sockets, etc. Attractive prices on all standard goods are contained in both price-lists.

THE INTERNATIONAL BRASS & ELECTRIC COMPANY, 76 Beekman Street, New York, has just issued its 1905 catalogue which is found quite complete, with illustrations and prices of its various specialties, including Ruhmkorff induction coils, automatic coils, spark plugs, wire connectors, brass binding posts, hexagon nuts, etc. This company also makes a specialty of experimental work, for which there is a very extensive demand.

WAGNER SINGLE-PHASE MOTORS are the subject of Bulletin No. 68, recently issued by the Wagner Electric Mfg. Company, St. Louis, Mo. These machines are fully described and illustrated, and several applications are shown.

BORING MILLS.—The Gishalt Machine Company, Madison, Wis., has issued a pamphlet descriptive of its vertical boring and turning mills, horizontal mills, etc. These machines are illustrated in an excellent manner on tinted paper, and all the principal features and dimensions of each are set forth.

KINSMAN SPECIALTIES.—A 1905 calendar issued by McLeod, Ward & Company, 27 Thames Street, New York, is a reminder for the year of the line of Kinsman specialties manufactured by this firm. It contains illustrations of Kinsman and Ward lamps for desks, picture galleries, typewriter desks, etc., and is attractively gotten up.

ELECTRICAL MICA.—Eugene Munsell & Company, 218 Water Street, New York, in their recently issued price-list of electrical mica give prices of cut mica of a large number of sizes, uncut sheet mica, ground mica, segments, washers, rings, etc. This house receives its supply of mica, both India and amber, direct from the mines, and claims to carry the largest stock of mica in the country.

INDUCTION MOTORS.—Bulletin No. 3062 of the Emerson Electric Mfg. Company, St. Louis, is devoted to a description and illustrations of the company's condensed types of automatic start induction motors for single-phase current. These motors are compact, of simple and durable construction and of low current consumption. They start automatically, being provided with a special device for this purpose.

ROEBLING CALENDAR.—The John A. Roebling's Sons Company has issued a monthly calendar for 1905 which illustrates, with a typical illustration, the various uses to which the company's products are applied. There are views of a telegraph line, a trolley line, a yacht, the two New York and Brooklyn big bridges, a wire rope power transmission plant, etc., etc. The figures of the calendar possess the merit of being clear, and distinguishable at a distance.

WINDOW LIGHTING is a subject of perennial interest to enterprising store-keepers. No doubt a well-lighted store window, together with an attractive display of goods, brings business. The H. T. Paiste Company, Philadelphia, Pa., has issued a neat little pamphlet on window lighting with Fielding material. Several illustrations show these devices and their application to the purpose of illumination. Fielding material includes receptacles and rosettes of many styles, suited for special conditions.

DOMESTIC ELECTRICITY.—The United Electric Light & Power Company, Baltimore, Md., is encouraging its customers in the more liberal use of electricity for the manifold purposes to which it can be applied in the domestic economy. In a recent booklet the company illustrates many aesthetic and utilitarian applications of electricity in the household, such as Christmas tree lighting, cooking utensils, heating apparatus, piano playing, fan motors, etc. Each illustration is accompanied by a few words pointing out the advantages of the device or apparatus so shown.

KNIFE SWITCHES.—A very extensive line of knife switches for switchboard work is described in Bulletin 6010 of the Western Electric Company. The company has developed two distinct lines of switches suitable for this purpose, which it designates as styles "F" and "G." The type "F" switch is manufactured in all standard sizes for rear-of-board connection only. The type "G" is also manufactured in all standard sizes and at the same ratings as the type "F" up to and including 800 amperes capacity, and is made for either front or rear-of-board connection. The two types of switches are illustrated, and diagrams are shown giving dimensions and other information. A code and price-list are also included.

COMPLETE TELEPHONES.—The Dean Electric Company, Elyria, Ohio, has issued the second of a series of booklets descriptive of Dean telephone apparatus. The apparatus described, and illustrated, includes magneto telephones, common battery telephones, metal box telephones, portable desk telephones, complete desk telephones, receivers, induction coils, hook switches, etc. The booklet contains much interesting matter on telephone operation, and in its get-up the work of a master hand is in evidence. The illustrations are notably clear and are evidently prepared especially for this work. The Dean system, as exemplified in this little pamphlet, is very completely developed and as well described. The contents of the booklet are above the average character of trade catalogues.

MEASURED TELEPHONE SERVICE EQUIPMENT.—A unique booklet has been issued by the Gray Telephone Pay Station Company, Hartford, Conn., illustrating and describing its varied line of telephone pay stations. The booklet is trimmed and bound in such a manner as to give it the appearance of being a thick volume. Its 44 pages contain illustrations and brief descriptions of the various styles of automatic telephone pay stations, comprising wall cabinet sets, cabinet desk sets, extension desk sets, street sets, etc. In dropping the coin in its proper slot a signal is made automatically, and toll collections are made and recorded accurately. This company first introduced its toll collector in 1888, and has since put over 130,000 of them into use. One of the illustrations shows a street pay station in use at Bridgeport, Conn., in connection with a mail box, both on the same post.

TOLL BOARDS.—Local exchanges are beginning to realize the fact that the only proper way to care for the toll branch of their business is by means of a separate and distinct board, built especially for this class of work. The Stromberg-Carlson Telephone Mfg. Company, Chicago and Rochester, recently issued an artistic catalogue on its toll boards for telephone exchanges. The toll line business and equipment of telephone exchanges is briefly considered in a well-written chapter, followed by a clear description of the construction of these boards. The details of construction are artistically illustrated in half-tone views, and various styles of complete boards are likewise shown. The pamphlet is made doubly attractive by being printed in two colors—the text in a light brown and the marginal index notes and illustrations in black. On the front cover is a map of North America, in the center of which is a view of a toll board from which lines to all parts of the continent radiate.

ELECTRICAL MEASURING INSTRUMENTS.—The Keystone Electrical Instrument Company, Inc., Philadelphia, has recently issued a very comprehensive catalogue on its standard direct-reading measuring instruments, for either direct or alternating current circuits, in switchboard and portable types. Sections I and II of the catalogue describe instruments of the electrodynamometer type and Section III instruments of the electromagnetic type. The construction of the instruments of the two types is shown very clearly by means of diagrammatic illustrations, accompanied by full descriptions. Tables give the code words for instruments of different ranges and capacities, together with prices and other relevant information. Many of the illustrations consist of dimensional diagrams and sample scales of the various kinds of instruments made by the Keystone Company. Altogether this is an extremely interesting pamphlet on the general subject of measuring instruments and can be read with profit. Its technical information is right to the point and of value to all interested in the use of instruments of this class.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JANUARY 10, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

778,908. SELF-PLAYING MUSICAL INSTRUMENT; Harold W. Shonnard, Newark, N. J. App. filed Jan. 16, 1899. The armature connections between the magnet and the sound producing agent, afford a gradually lessening leverage in favor of the magnetic effort as the pole of the magnet is approached. (Issued Jan. 3.)

779,402. GLASS BASE FOR FURNITURE; Mary I. Abrams, Milwaukee, Wis. App. filed April 18, 1904. A glass block adapted to be fitted to the castors of furniture for insulating purposes.

779,427. ELECTROMAGNTIC METAL WORKING MACHINE; Francis W. Jessop, Cleveland, Ohio. App. filed March 30, 1904. The invention consists in combining with the die, punch, shears, hammer or other tool, an electro-magnet and power-multiplying mechanism intermediate thereof, whereby a powerful blow or stroke may be imparted to the tool.

779,428. BAKER'S OVEN; Engelbert Kaiser, Chicago, Ill. App. filed July 7, 1904. An oven having hollow vertical walls constructed of porous material such as brick and having the portions above and below the baking-chamber constructed of layers of sand with comparatively moisture-proof intervening layers of denser material, and electric wires for heating said oven embedded in said layers of sand.

779,432. POLYPHASE MAGNET; David L. Lindquist, Yonkers, N. Y. App. filed May 23, 1904. This invention consists of a polyphase magnet having a plurality of coils in circuit with a single phase current supply and means for converting the single-phase current into two-phase of ninety degrees phase difference.

779,441. TROLLEY DEVICE; Henry O. Reese and Henry C. Weitzel, Baltimore, Md. App. filed June 10, 1904. Two trolley wheels are mounted in opposite ends of a centrally pivoted rocking arm carried by the trolley pole, in the head of which stops limiting the rocking motion in either direction are placed; the object being to insure contact with the wire at all times.

779,443. TELEGRAPH AND TELEPHONE TRANSMISSION-LINE; Eugene Franz Roeber, Philadelphia, Pa. App. filed March 9, 1901.

779,447. ELECTRIC CONTROLLER; August Sundh, Yonkers, N. Y. App. filed June 3, 1904. Improvements on a former patent to same applicant, the object being to improve the construction so that a single electromagnet may serve, by means of a single circuit-closer, to control circuit in the motor or other translating device and also actuate a sliding arm whereby resistances are cut out of or into the circuit of said device in starting and stopping the same.

779,469. COUPLING FOR ELECTRIC CABLES; John J. Dossert, New York, N. Y. App. filed July 16, 1903. The ends of the cables are fitted with internally threaded coupling sleeves which are slipped over the strands of the cable and secured in place by a bulge formed in the strands. A third or intermediate element having threaded opposite ends joins the ends of the cable by engaging both the threaded coupling sleeves.

779,475. SYSTEM OF ELECTRICAL DISTRIBUTION FOR ELECTRIC RAILWAYS; Josef H. Hallberg, Cincinnati, O. App. filed Feb. 26, 1904. In this system the generator is of alternating single-phase current. The trackway is divided into sections one being fed directly from the single-phase current and the other from low-potential polyphase currents, there being means introduced between the trackway of one of the sections and the generator for converting the high potential alternating single-phase current into low-potential polyphase currents. Apparatus carried by the vehicle affords means for operating the motors by the high potential single-phase current when on one section of the railway and by the low potential polyphase current when on the other section.

779,497. APPARATUS FOR TELEPHONE TRUNK-LINES; Walter Otis Pennell, Philadelphia, Pa. App. filed Nov. 23, 1900.

779,504. TELEPHONE BRACKET; Samuel J. Seigfried, Chicago, Ill: App. filed Sept. 25, 1903.

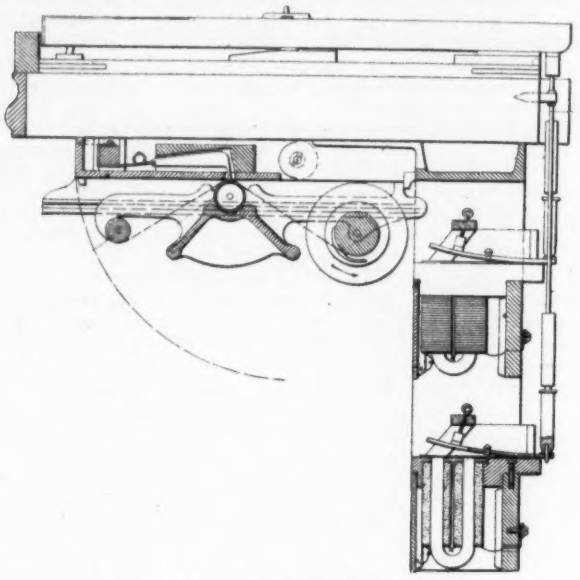
779,508. ART OF ELECTRICAL WAVE TRANSMISSION; Daniel M. Therrell, Atlanta, Ga. App. filed Feb. 17, 1902. Relates to the construction of electric speaking telephone systems, being a device or system for improving the transmission of speech through conductors or cables of great length which are characterized by high retardation effects operating to destroy the overtones, and thus the definition and articulate qualities of the transmitted speech.

779,524. PRINTING TELEGRAPH SYSTEM; John Burry, Ridgefield Park, N. J. App. filed April 9, 1904. Improvements on a former patent. Relates principally to mechanism for repeating a character any desired number of times.

779,532. CONNECTION BOARD FOR DYNAMO ELECTRIC MACHINES; John G. Crawford, Lagrange, Ill. App. filed May 13, 1904. Relates to means for mounting the board on the machine, so that a safe separation may be maintained between the live electrical terminals and the ground frame.

779,533. PARTY LINE TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 15, 1903.

779,539. ELECTRIC ARC LAMP; Walter C. Fish, Lynn, Mass. App. filed June 24, 1901. Employs a device supplemental to the arc-controlling mechanism for breaking up the oscillations of such mechanism, the device possessing



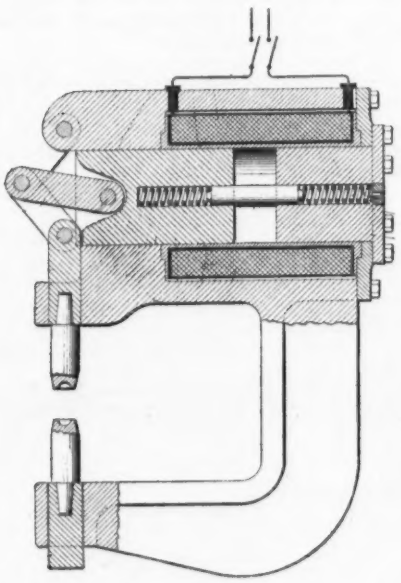
778,908.—Self-Playing Musical Instrument.

considerable inertia and being connected to the arc controlling mechanism by springs.

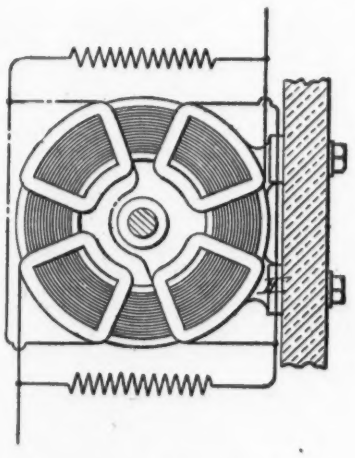
779,554. TROLLEY BRIDGE; Robert T. McCarroll, Columbus, Ohio. App. filed June 4, 1904. This invention is especially adapted to car-barn doorways in which steel rolling curtains are employed, and has for its special object to provide a pivoted bridge-piece which is adapted to close when the curtain is drawn up, and thus bridge the opening in the trolley line through which the curtain passes, thereby affording a continuous unbroken guide for the trolley wheel.

779,575. POLYPHASE WINDING; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 6, 1903. The winding of each phase consists of a series of concentric coils alternating with a series of coils of a less number than in the series of concentric coils.

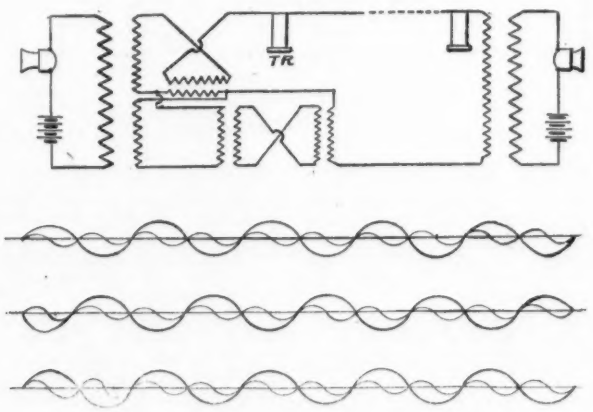
779,592. SIGNAL SYSTEM FOR ELEVATORS; Bartholomew J. Foley, Pittsburg, Pa. App. filed March 12, 1900. The invention consists in providing a signal system for elevators of building, wherein the "call" and "release" circuits are independent and in which current is used only for the instant that the call is made and the release effected. The signal



779,427.—Electromagnetic Metal-Working Machine.



779,432.—Polyphase Magnet.



779,508.—Art of Electrical Wave Transmission.

being set for the car operator by the call, it will remain set until released by him. The signal-circuit is normally open and is only closed by the car when it is at the given point for which the call-circuit was operated.

779,612. CABLE REEL; Carl W. Larson, Schenectady, N. Y. App. filed June 1, 1903. Provides means for winding and unwinding a flexible electric conductor upon a reel carried by an electric locomotive used in mines.

779,623. ELECTRIC PUMP; Edwin F. Porter, Boston, Mass. App. filed Feb. 9, 1903. Comprises a pump operated by an electric motor and a rheostat operated by the flow of fluid through the pump for controlling the action of the pump.

779,640. SUSPENSION DEVICE FOR TROLLEY WIRES; Theophilus P. Chandler, Philadelphia, Pa. App. filed Oct. 7, 1904. Combines two gripping parts or plates each having two oppositely arranged jaws adapted to extend partly around the wire on opposite sides and jointly inclose it for more than half its circumference, the parts or plates being formed with a gap or clearance-space between the jaws to receive the wire and allow it to come into the plane of the jaws.

779,654. TROLLEY RETRIEVER; Emil J. Jonas, Hamlet, Ohio. App. filed April 1, 1904. Involves the use of a compressed air device by which the trolley when it has jumped the wire will be lowered immediately to a safe position, out of the way of guy wires and the like.

779,659. INSULATOR; Fred M. Locke, Victor, N. Y. App. filed May 31, 1904. A device for linking two parts together to resist opposite strains, comprising a metal cap having an eye on one end and a threaded socket in its opposite end, a hub of insulating material inserted in said socket and a metal rod secured to the hub.

779,670. TELEGRAPH SYSTEM; Harry Shoemaker, Philadelphia, Pa. App. filed Oct. 11, 1902. Includes means for impressing upon a circuit impulses differing in strength and polarity, a branch including a relay responsive to the stronger positive impulses and a relay responsive to the strong negative impulses, a branch including an asymmetrical resistance permitting the passage of positive impulses and a branch including an asymmetrical resistance permitting the passage of negative impulses.

779,673. HIGH FREQUENCY INDUCTION APPARATUS; Charles L. Spaulding and Robert E. Austin, Kansas City, Mo. App. filed April 25, 1904. The apparatus consists in its essential features of a plurality of primary and secondary coils and a condenser in circuit with the primary coils. The latter are preferably connected with the secondary coils.

779,720. VOLTAGE REGULATOR; Orra M. Lacey, Hanford, Cal. App. filed Nov. 9, 1903. Comprehends an apparatus by which the voltage of a current of electricity may be constantly and automatically regulated to any desired point. This is effected by a fluid-pressure acting in opposite directions upon pistons of different area, the flow of the fluid being controlled by valves actuated directly by the movements of a volt-meter, and the movement of the piston is transmitted directly to the rheostat or other controlling device.

779,737. SHUNT FOR ELECTRICAL MEASURING INSTRUMENTS; Lewis T. Robinson, Schenectady, N. Y. App. filed Aug. 18, 1904. Comprises a resistance-strip having heat-radiators in good thermal relation at distributed points throughout its surface.

779,739. PROTECTIVE DEVICE FOR THIRD RAILS; John Ryan and Anthony C. Guntzer, New York, N. Y. App. filed Nov. 5, 1903. Details of a housing for third rails.

779,810. ELECTRIC BRANDING APPARATUS; David C. Sprecher, Kansas City, Kan. App. filed Nov. 15, 1904. Comprises a stationary electrode and a movable electrode, one being in the form of a branding iron of materially less contact area than the other.

779,811. SELECTIVE PARTY-LINE TELEPHONE SYSTEM; Albert J. Springborn, Cleveland, Ohio. App. filed April 3, 1903.

779,814. BRUSH HOLDER; Christian L. Staver, Schenectady, N. Y. App. filed Oct. 23, 1899. Comprises a brush slidably connected to its support and having a yielding conductor connected to the support and positively and detachably secured in place in electrical connection with the brush.

779,828. INSULATOR PIN; Montraville M. Wood, Schenectady, N. Y. App. filed Aug. 8, 1903. The pin is made from a seamless steel tube, having a shoulder upset upon it to rest on the cross-arm, threads rolled in its upper end on a taper, and a fastening-bolt inserted into its lower end and secured by inwardly-pressed portions of the tube under the bolthead.

779,850. TROLLEY FOR ELECTRIC RAILWAYS; George C. Hohein, Norfolk, Va. App. filed Sept. 17, 1904. Details.

779,875. AUTOMATIC MOTOR STARTING RHEOSTAT; Ernest Schattner and Caryl D. Haskins, Schenectady, N. Y. App. filed May 13, 1904. Employs a self-reducing resistance—that it a resistance the ohmic value of which is decreased by the passage of the current through it.

779,892. TELEPHONE SELECTING SYSTEM; William David Watkins, San Jose, Cal. App. filed May 1, 1903.

779,893. SELECTIVE SIGNALING SYSTEM; William D. Watkins, San Jose, Cal. App. filed Nov. 4, 1903.

779,895. SIGNALING CIRCUIT FOR RAILWAYS; Adoniram J. Wilson, Westfield, N. J. App. filed Feb. 10, 1902. Details.

779,907. MOTOR AIR PUMP; Edward Cheshire, Milwaukee, Wis. App. filed Feb. 13, 1904. Details for compressed air apparatus aiming at automatic lubrication and protection from dust, water, etc.

779,940. SUPPORT FOR TELEPHONE RECEIVERS; Frank F. Howe, Marietta, Ohio. App. filed Sept. 23, 1904.

779,948. ELECTRIC ARC LAMP; Geinrich Lux, Schoneberg, Berlin, Germany. App. filed June 8, 1904. Details for a lamp intended to operate at a low amperage.

779,982. SELECTIVE TELEPHONE SYSTEM; Peter J. Albrecht, Marion, S. D. App. filed July 25, 1904.

779,996. INDUCTANCE COIL; Walter C. Fish, Lynn, Mass. App. filed Sept. 3, 1903. Consists of a core, a main winding carrying a unidirectional current subject to fluctuations, and a counter-magnetizing winding excited by direct current.

779,999. BOWLING ALLEY; Paul A. Hanerl, Denver, Col. App. filed Feb. 27, 1904. Relates to means to facilitate the proper and exact placing of the pins and also to an electrical connection whereby the knocking down of the pins is clearly indicated by the position of pointers mounted in suitable proximity to numbers corresponding with the numbers of the spots upon which the pins are placed.